DOMESTIC SCIENCE

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FOR HIGH SCHOOLS IN INDIA

PART II

BY

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TO ALL GIRLS IN INDIA

PREFACE

Our ancient literature, especially the *Bhagavad Gita* and the Beatitudes, provide, in song and story, the precepts used by mothers in the *moral* training of their children. This training is of the first importance; for of what value is life if it be not directed and controlled by right principles of conduct, and the understanding of spiritual law? On the other hand, how much better can we accomplish our spiritual and intellectual mission if we possess good health.

The present text is presented with the hope that it may acquaint young women with the *physical* precepts which will not only assist them in attaining good health for themselves, but that future generations will reap the benefit from stronger motherhood. It is every child's birthright to be *born well*, if not 'well-born'. They deserve strong constitutions as their heritage, and to be brought up in sanitary, cheerful homes. With training in right health habits, provided with adequate food, they will at least have the physical endowment for happy and successful lives.

We cannot lay blame to *karma* for matters which have been proved to rest on broken physical laws in this life. It is, however, the previous misdeeds and wrong manner of living of parents for which the little children suffer. Therefore it is necessary to give attention to pre-natal conditions that we may ensure a healthful inheritance for our babies.

To lakhs of people who die, there are crores who survive with feeble constitutions due to preventable causes. As we love India, and hope for her development and equal status with other Dominions, it becomes our duty to inform our-

selves of the causes which bring death to her people at an average age of twenty-seven years, while people of other lands live twice as long.

The object of this volume is to bring to the young women of India the most modern knowledge of scientific facts, taken from the books of the best authors to-day available. There is little that is original in the text, but the compilation of facts has been made with the conditions of life in India kept in view.

Having lived several years in India, with experience in the schools of one of the most progressive Indian States, the author has utilized that experience to guide her in selecting and presenting the subject matter of this text, with the hope that it may be of real value to women and girls in India.

As a companion volume to Part I, prepared by Miss M. A. Needham, Principal of the Maharani High School for Girls, Baroda, the attempt has been made to supplement her book, and cover the Matriculation syllabuses of Indian Universities. The wider purpose, however, is to stimulate interest in healthful living and the art of home-making.

Few students can own many books; but the school library should contain copies of the books referred to in this text, to afford opportunity to teachers and pupils for wider reading on subjects which could be but briefly touched upon in this small volume. Practical work in chemistry laboratory and kitchen should at all stages accompany the theoretical work. The keeping of a careful note-book should be a part of the requirements of the course, and data should be collected to supplement the data of the text. Most important of all is that we put into daily practice the facts we learn, and thus cultivate right habits of living.

I wish to acknowledge the kindness of Dr. Marion Whyte and Miss Airini Pope, lecturer in Chemistry and Nutrition

(Otago University), for reading parts of the manuscript and offering valuable suggestions. To Miss Mabel Needham, for inspiration and criticism, without whose suggestion the work would not have been undertaken, I make especial acknowledgment. To Dr. Robert McCarrison, Director of Nutritional Research, Pasteur Institute, Coonoor, I am indebted for sympathetic approval of the project and helpful suggestions from his writings, particularly the recent book, *Food*. Miss Challis Hooper, Secretary of the Plunket Office, Dunedin, New Zealand, has been of much help in compiling the tables of feeding formulæ for Indian infants. To Sir F. Truby King, Founder and President, and Miss Patrick, Dominion Secretary of the Royal New Zealand Society for the Health of Women and Children, I am indebted for permission to use data from their pamphlets, published by Messrs. Macmillan & Co. Ltd., London.

I wish further to acknowledge the useful statistics compiled by my post-graduate students of Baroda College, whose friendship gave me insight into conditions of home-life in India.

This volume has been written during the vacations and holidays of a busy professional life. My thanks are due to Miss May S. Martin and Miss Kathleen Barker for their willing sacrifice of their own holiday time in order to render valuable assistance.

I wish especially to acknowledge the courtesy of Dr. Mary Swartz Rose, Dr. Henry Sherman, Dr. Jessie Feiring Williams, Dr. John Woodside Ritchie and Miss Margaret Anna Purcell, and Dr. W. H. Conn, for permitting free quotations from the books of which they are the authors; as well as my appreciation of their publishers, The Macmillan Company of New York; Ginn and Company, Boston; The World Book Company, New York. I also acknowledge, with grateful thanks, the permission, given by Dr. Helen Swift Mitchell, to reproduce the photographs of rats.

Permission, which we gratefully acknowledge, has been generously given to use the following texts and illustrations in the compilation of this book :

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2. Ginn and Company, Boston, U.S.A. :
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7. D. Appleton & Co., New York, U.S.A. :
   Nutrition and Growth in Children. By William R. P., Emerson, A.B., M.D.
8. J. and A. Churchill, 17 Marlborough St., London :
   Mothercraft Manual. By Mabel Liddiard, S.R.N.
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11. Lee and Febiger, New York :
   Nutrition and Clinical Dietetics. By Herbert S. Carter, M.A., M.D.; Paul E. Howe, M.A., Ph.D., and Howard H. Mason, A.B., M.D. (3rd edition).

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13. The Macmillan Company, New York:
    (1) *The Newer Knowledge of Nutrition.* By E. V. McCollum, Ph.D., Sc.D., and Nina Simmonds, Sc.D. (Hygiene).
    (2) *Foundations of Nutrition*;
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    (4) *Laboratory Manual of Dietetics.* By Mary Swartz Rose, Ph.D.
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A. G. STRONG

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APPENDIX

CHAPTER I

HEALTH AND BODY STRUCTURE

'It is within the power of every living man to rid himself of every parasitic disease.'—*Pasteur.*

Required.—Knife, platinum wire, test tubes, microscope, magnifying glass with a ⅔ and ⅙ inch objective, glass slides, cover glasses, bell-jar or basin, medicine dropper, methylene blue, bread, lemon, banana, water, treacle, yeast, lime water, cotton wool, cooked rice, flour, beans or dhal, sugar, ghee, gram, maize and milk.

How may health be maintained?

What causes sickness?

We are interested in seeing India develop and become a strong and prosperous country; but this hope is deferred largely by the fact that the majority of our people do not live long enough to gain wisdom and take responsibility. True patriotism can be shown by keeping healthy as well as by studying and gaining knowledge.

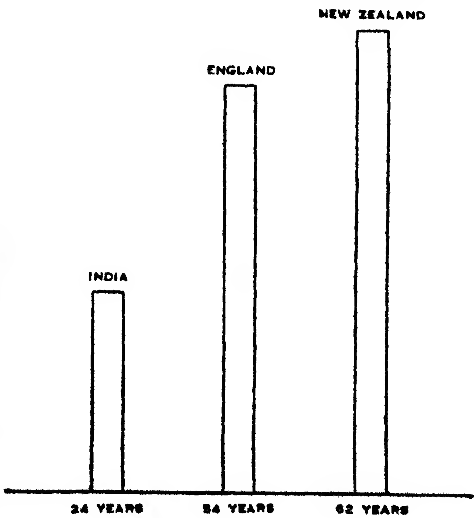

Fig. 1

The length of life of people in India compared with those in other parts of the Empire

In Europe, 300 years ago, the average length of life was only 24 years, and that is what it is in India now. In England the average length of life has been extended to 54 years. In New Zealand they have increased the average length of life to 62 years (Fig. 1). Much more can be accomplished in 62 years than in 24. How have they been able to lengthen the life of people in these countries ?

The habits formed with respect to food, clothing, shelter, cleanliness, sleep, exercise and rest, are factors which determine the growth of our bodies, our power to resist disease and the length of time we shall live. A plough or an engine wears out quickly if it is neglected ; but it will last many years if given proper care. So our human bodies, which are something like engines, may last many years if given good care, or may be destroyed in infancy by impure milk, or may, after many years of active life, be destroyed by fever germs.

Do you realize that we have more sickness in India than in other

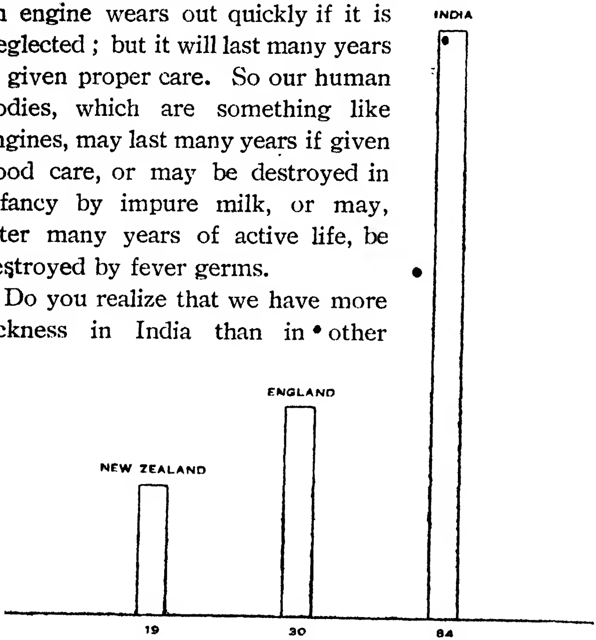

Fig. 2

The daily average number of sick persons per 1,000 inhabitants in various parts of the British Empire

countries? Do you know that fully half of it is preventable? In New Zealand there are only 19 persons ill, daily, per 1,000 of the inhabitants; in England there are 30 persons ill, daily, per 1,000; but in India there are 84 persons ill, each day, out of every 1,000 inhabitants (Fig. 2).

We profess great reverence for motherhood; but while in Denmark only about 2 mothers out of every 1,000 die when the baby is born, and in England only 4 die out of every 1,000, in India there are 20 mothers of every 1,000 die in childbirth. Lowered vitality, disease and death prevail in such high percentage because of our ignorance of the laws of health. Some people believe that disease is sent by the gods or demons, or that health comes by chance or good fortune. We know, however, that obedience to the laws of health is the way by which we may keep well and build up our power to resist disease.

It is only when we lose our health that we begin to appreciate it. In times of plague or during a cholera epidemic, we are more ready to seek advice and obey it; but a 'tola of prevention is worth a maund of cure'. Health is our account in the 'bank of life', our reserve of silver and brass. It can be used up, wasted, lost or stolen, leaving us bankrupt of health and dependent upon others.

Who is it that can rob us of our health? There are many enemies to health lurking about, and we need to know their habits in order to protect ourselves from them. Like other 'robbers' they 'love darkness better than light, because their deeds are evil'. They hide in dirt and all uncleanliness. They remain wherever they have fallen, if the place is moist, but if dry they will be wafted about by every breeze, riding upon the dust particles as on airships. If your mouth happens to be open, they may fly in and set up housekeeping in this dark, damp, warm place, where food may be found between the teeth. These tiny creatures are not all evil in their deeds. Some *bacteria* are our friends; but we need to

know about them and their habits, if we are to avoid disease, maintain health and increase our length of life.

The causes of disease. A wise Frenchman, named Pasteur, was so deeply concerned about the loss of human life and of efficiency as the result of disease, that he devoted his life to the study of the *causes* of disease. He found these to be largely due to a hitherto unknown world of micro-organisms, unknown because they are so small that they can only be seen under a high-power microscope. These tiny living organisms, or *bacteria*, which are so small that it is almost impossible to determine whether they are plant or animal, are often called *germs* or *microbes.*

SPECIES OF COMMON MOULDS

Friendly micro-organisms. Some of these micro-organisms are our friends. One group of friends is called *yeasts* (Fig. 3), and these are important in raising our light bread. Some yeasts are troublesome; but we may consider yeasts, for the most part, as our useful servants. Later we will learn how to make them work for us in our food preparation.

Fig. 3
Yeasts budding

Experiment 1. *Fermentation of treacle or gul (jaggery)*

Into a common test tube or any glass vial place a solution made by mixing one spoonful of treacle with ten spoonfuls of water. Add a little yeast to the tube of treacle water. Set aside in a warm place and let it stand for about twenty-four hours. At the end of this time a vigorous fermentation will be seen. The liquid will have become somewhat cloudy. Numerous bubbles can be seen rising through it, a froth forms on top and a mass of sediment soon collects at the bottom. The bubbles are the *carbon dioxide* which is escaping into the air, the sediment at the bottom is the growing mass of *yeast*, and the *alcohol* which looks just like water is dissolved in the liquid and is, of course, invisible.

Experiment 2. *Growing yeast*
With a pipette remove a drop of the sediment from growing yeast prepared as in Experiment 1. Place the drop on a slide, cover with a cover glass and study as in the previous case. Remove some of the yeast found floating on the surface and study in the same way. Note that the yeast cells are in groups (Fig. 3). Make a sketch of several groups, showing buds of various sizes. Can you see the vacuoles in the cells, as in the first specimen?

Experiment 3. *Wild yeast*
Prepare several test tubes of molasses, or gul and water as described, and, without plugging with cotton, leave exposed in various places for two or three days. Determine by the appearance of bubbles whether fermentation occurs. If any change takes place in the liquids, examine with a microscope to determine whether some other micro-organisms are growing in the solution. Commonly *bacteria* will be found more abundantly than yeasts.

Experiment 4. *Action of yeast on bread*
Mix up a little flour and water to about the consistency of dough for bread making, and divide into three lots (*a*, *b* and *c*). Into *a* and *b* place a little yeast. This may best be done by dissolving the yeast in water and stirring it into the dough during the mixing. *a* and *b* are then to be placed in a *warm* place for five or six hours, while *c*, without the yeast, is to be baked at once. After *a* and *b* have risen under the influence of the yeast, bake *b* at once in the oven, while *c* is to be thoroughly kneaded and then baked. Compare the results of *a*, *b* and *c*, noticing the difference in the textures of the bread.

Even *moulds* (Figs. 4, 5 and 6), which are such a nuisance to us during the monsoon, causing our books, shoes and foods to be spoiled, are sometimes friends, as they help to produce appetizing flavours.

Experiment 5. *Moulds on different foods*
Under separate dishes, that will protect it from evaporating, place bits of bread, some pieces of lemon and a bit of banana, etc. Each of these should be moist. Cover and

set aside. Moulds will grow in a few days, but probably different species will form upon the different materials. Compare the moulds and determine how many kinds can be seen (Figs. 4, 5 and 6).

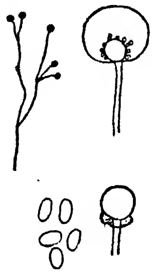

Fig. 4

A Species of Mucor

Experiment 6. *Spores*

After the moulds of the previous experiment have begun to produce spores as shown by the appearance of some colour, remove a little spore material from the surface with a knife blade or a platinum wire and examine under a microscope. For this purpose a compound microscope is necessary, since the spores are very small.

Experiment 7. *Growth of mould from spores*

Moisten a bit of bread and transfer, with a platinum wire, a little bit of the spore mass from a vigorously growing mould to the surface of the bread. Cover with a glass and set aside for growth. Examine every day and note that moulds start from the points where the bread was inoculated with the mould spores.

Bacteria change our milk into curds and are useful in the manufacture of vinegar. They are also the means of fixing nitrogen in the soil, making it more fertile for farming. They break up the waste matter which is thrown upon the earth and purify sewage.

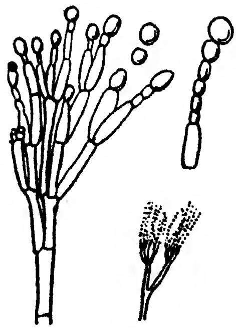

Fig. 5

Penicillium

Experiment 8. *Effect of temperature upon milk*

Fill six test tubes full of milk. Place two of them in an ice chest, two at ordinary room temperature, and two close to a stove or radiator where the temperature is very warm. Examine at intervals of three or four hours, and note the time at which the tubes become sour and curdle. Determine, if possible, whether there is any difference in

the appearance or smell of the curdled milk in the three samples.

Experiment 9. *Washing of milk vessels*

Place some ordinary milk in two test tubes and set aside until the milk sours. Pour out the milk from all the test tubes and wash one with cold water and the other with hot water and soap. Hold the tubes up to the light and notice the difference in the cleanliness of the two test tubes. Now fill each tube with fresh milk and set aside in a moderately cool place, and notice in which of the tubes the milk sours first.

Unfriendly micro-organisms. There are some varieties of bacteria, yeasts and moulds which are unfriendly, and when these get the opportunity they cause disease. It is our business to know how to prevent these 'robbers of our health' from obtaining access to our bodies and making us ill. One way of preventing disease germs from harming us is to learn what things are favourable to their growth, then we can avoid these conditions, or create conditions which they do not like.

Size. Some bacteria are so small that you would have to put 50,000 in a row to measure even one inch. Even the larger ones are so small it would take 10,000 of them to measure an inch. You might imagine that anything so small could not possibly harm us. The reason we have to fight them so hard is that they multiply more rapidly than anything you can conceive of and, as they are so small, we do not know they are there until after they are well established and doing their damage, either to our food or to our bodies.

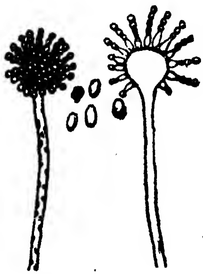

Fig. 6
Aspergillus

Classes. There are two classes, or castes, of micro-organisms to be considered. Those that live on dead food are called *saprophytes*, and we will

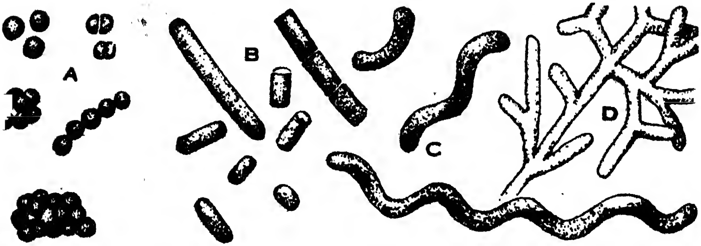

Fig. 7

The four types of bacterial cells: A, cocci; B, bacilli; C, spirilla; D, branched filamentous organism.

discuss them later in connexion with food preservation. Those which carry on their lives within the living body of plants and animals, including human beings, are known as *parasites*. The micro-organisms that live and multiply within the body of a living creature may produce *disease*, and that is why they are called *disease-germs* or *pathogenic bacteria*, etc. Some germs, however, have the power of living both upon dead and also upon living matter, so they belong to both classes.

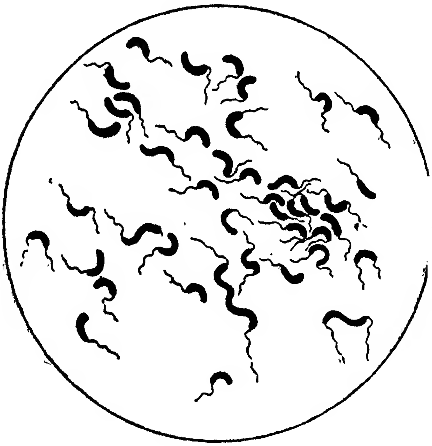

Fig. 8

These bacteria are the cause of cholera and are called cholera spirillæ. They have small hairlike processes which serve as tails for locomotion. These are called flagellæ.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Shape. Bacteria, or germs, cannot be

seen except by the very highest power of the microscope. Some germs are round, others are oblong, some are spiral and others are rod-like in shape. Some are smooth and others have hairlike processes called *flagella* by which they are able to move very rapidly through the water (Figs. 7, 8 and 9).

There are so many different germs which look alike that bacteriologists (specialists in *Bacteriology*) have to rely upon other methods of identification than shape and appearance.

Multiplication. Their method of reproduction is extremely simple. The bacteria grow to full size, and then divide in the middle. This method is called *fission*, and you can see it would not take long. In fact, a bacterium can grow and multiply so rapidly that it is difficult to realize it. Suppose you try to calculate with pencil and paper how many progeny one germ would have in twenty-four hours, if it divided by fission every half hour. You will need to use geometrical progression to figure this out, and you would find that even in *half* that time the germ would have about 17,000,000 offspring. When you realize that in one day a germ will

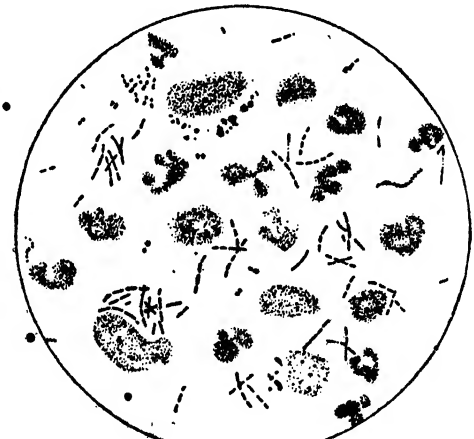

Fig. 9

Tubercle bacilli in sputum of a person having tuberculosis of the lungs

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

produce millions, nay crores, of other germs, you can see what a very great danger they become if they happen to be parasitic disease-germs, and if that growth is within your body you can see, too, that if we intend to protect materials and ourselves from the germs we must not leave a single one, or it will soon produce enough descendants to accomplish much damage. In order for the germs to keep up this rapid growth, it is necessary for them to have food and other favourable conditions, most important of which is the right temperature.

Spores. Bacteria have a different way of multiplying under some circumstances. They form within themselves round masses, called *spores,* which break out and are able to germinate into new individual germs (Fig. 10).

Temperature. One of the chief reasons why germs grow so rapidly in India, spoiling our foods and causing epidemics of disease, is that the warm climate is very favourable to their multiplication. Cold does not actually kill them, but it retards their growth, so people in a cold climate have an easier task in keeping well than we do where the warmth is just what the germs like. Most bacteria grow best at a temperature between 79°F. and 95°F. What is the temperature of your body? Do you think germs would find this would help to growth?

Fig. 10
Development of bacterial spores

Experiment 10. *Effect of temperature*
Place bits of cooked rice with a little water in three test tubes. Put the first tube in an ice chest, the second in ordinary room temperature, and the third where the temperature is high. Notice the rapidity of fermentation in each case.

Micro-organisms do not like it too hot, however, and that is what saves us in India. The beneficent sun shines so hot that any germs which are left exposed to its rays are destroyed very quickly. But I must remind you that

bacteria can change into spore form. These spores have a harder covering than bacteria and are able to resist heat. They can be dried and still live. They may even be boiled and not destroyed. All bacteria do not form spores and those that do not are readily destroyed by boiling. We can by long continued boiling, or intermittent boiling, kill them all. Usually heating to the boiling point is sufficient to make any substance *sterile.*

Experiment 11. *Effect of boiling*
Take some milk, warming slightly but not heating it to more than 130°F. Divide into two parts, place each in a test tube, setting one aside without further treatment, but bringing the other to a brisk boil for a moment and then setting beside the first. At the end of twenty-four hours examine to determine if fermentation has occurred.

Experiment 12. *Effect of boiling*
Prepare two test tubes of treacle, or gul and water, and inoculate both with a drop of yeast. Plug with cotton. Place one test tube in water and boil for ten minutes, and then leave both test tubes side by side in a warm place for two days, and determine whether the boiling has been sufficient to kill the yeast.

Pasteur, the eminent Frenchman of whom we have spoken, discovered that the temperature of about 155°F. is sufficient to kill most bacteria. That is why heating to this temperature is called *pasteurizing.* It is best, in India, to heat materials to the boiling point, if we wish them to be really safe and scientifically clean. We will have more to tell about this in our cookery and nursing lessons.

Light. The germs grow best in darkness, and therefore we can prevent them from growing and multiplying by letting the sunlight daily into all our rooms. Dirt placed out in the sun will have most of the germs destroyed; but left in a dark corner the germs will multiply rapidly, particularly if the place is moist and warm. This is to be remembered when we talk of the care of the sick.

Moisture. We have said that germs must have moisture to grow and multiply. The spores may keep alive for a long time under dry conditions; but the bacteria themselves cannot absorb the food they require for growth unless it is wet. We shall see the application of this in our food study.

Experiment 13. *Effect of moisture*
Place a little of the following foods in separate test tubes: dry beans or grain, Indian maize meal, a piece of dry bread, wheat meal, atta flour, and common biscuit. In another series of test tubes place the same materials *moistened with water.* Set all aside in a warm place and notice the effect of water in bringing about putrefaction.

Experiment 14. *The effect of drying*
Place under a bell-glass two slices of bread, one of which is damp, either naturally or by being slightly moistened with water, and the other dried. Leave for two or three days and notice the effect of drying in preventing the growth of moulds. If one slice remains dry no moulds will grow upon it, though the other soon becomes covered.

Air. A majority of bacteria require oxygen, just as we do, to live and grow. That is why decay of food often begins on the surface. But this is not true of all bacteria, for some grow quite well without oxygen. But currents of air retard growth.

Experiment 15. *Effect of air currents*
After it shows a luxuriant growth of mould, remove the glass and leave it exposed to the currents of the air. Notice how the growth of the mould ceases and the delicate mycelium flattens down close to the bread.

Distribution. Bacteria, or germs, are to be found practically everywhere on the surface of the earth, in the air, water and food, and therefore it will not surprise you to know they are present in large numbers in our mouths, stomachs and intestines. Perhaps you can see some bacteria taken from the surface of healthy teeth, if you have a high-power microscope.

Experiment 16. *Bacteria*
Scrape a little tartar from a healthy tooth with a clean piece of wood or toothpick. Suspend the scraping in water or salt solution and spread upon a glass slide. Cover with a cover glass, and examine under the microscope.

Further microscopic study requires a high power microscope and more apparatus than can be found in an ordinary school.

We have learned that there are two great classes of micro-organisms, or germs, and that the *saprophytes* use the same kind of food which we do for sustenance, dead animal and vegetable food. In consuming this food they break up the chemical molecules, leaving only fragments quite unlike the original substance. These are called *by-products of decomposition*, some of them are gases, some liquids. So the food in which bacteria have been working is almost sure to become more liquid, and the gases given off produce odours and new tastes. This process is spoken of as *putrefaction* if it takes place where there is little oxygen, and is called *decay* if it takes place where there is plenty of air.

Experiment 17. *Putrefaction*
Place in a series of test tubes, with a little cold water, the following: some atta, crushed dhal or gram, sugar or gul, melted ghee and white of egg. Set all these tubes in a warm place for two or three days, and determine which will putrefy and which will not.

But besides these decomposition by-products, produced by the action of the bacteria, they also *secrete* substances, just as any living creature will do. Our own bodies secrete perspiration, urea, etc., and germs also secrete substances. The secretions of some bacteria are quite harmless, but those of others are very *poisonous*.

Disease bacteria, or germs. We have learned that the other great class of bacteria are called *parasites* because they grow and multiply in living bodies. Though we group

them together in this way, they are really many different species with widely different habits. We are now to consider some of these, with a view to seeing how we can avoid them. Sometimes they go into all parts of the body, and sometimes they locate themselves in one part, but wherever they find a chance to grow inside us they multiply rapidly and form decomposition by-products and secretions, just as the saprophytes do in lifeless food. Some of these secretions and by-products are poisonous, and are called *toxins*. When these toxins are absorbed into our blood, the body is poisoned. Sometimes the bacteria themselves do not enter the body, but, growing in the throat or intestines, their *secretions* are absorbed into the blood, and so the whole body is poisoned. This is true of *cholera*, where the germs grow in the intestines and their secretions are absorbed with the food into the blood, and thus distributed over the body. Something similar is true of practically all disease-germs. All produce poisonous materials which are absorbed by the body, and these cause the injury to the body which we attribute to disease. We are to learn that *malaria* is due to minute *unicellular parasites* existing in the red corpuscles of the blood. They divide into spores and burst the blood corpuscles, discharging the poison into the blood. A portion of the life of these parasites is passed in the stomach of the anopheles mosquito which is called an *intermediary* host, just as the rat-flea is an intermediary host for the plague.

There are also *multicellular* parasites, which afflict mankind, known as *hydatid* and *tape worms*. The hosts of the former are sheep and dogs, and of the latter pigs and dogs. These parasites grow in the bladder and intestines of man. Some varieties form cysts. They usually gain entrance to man through uncleanly ways of living or undercooked meat. You will realize that healthy people catch disease from sick people, and perhaps you wonder how this can be done. If a

man has chôlera and his friends come to see him, even for a short time, you will later hear that some of them have the disease also. You notice how plague, smallpox and sore-eyes seem to go through a whole family and spread throughout the neighbourhood. The diseases that can be spread in this way are due to *germs*, and are, therefore, called *infectious* diseases.

The germs that are making the man sick can be passed to another person in various ways, according to the disease. Since people who are sick with germ-diseases can infect others, we realize how very important the care of the sick is, not only to help them to get well, but to prevent others from contracting the same disease. The germs must be *destroyed as they leave the body* of the sick person, if possible, and we must also *prevent germs from entering the bodies* of the healthy people. The lesson which we will gather from this is that we must know how the disease germs leave the body and how they may be destroyed. We must find how they are distributed, and how they enter the bodies of healthy people, so that this may be prevented. Then we will discuss the case of the person who is sick and the way the body deals with disease.

You may ask, 'Why are we spending so much time talking about disease and sickness?' It is not a very pleasant subject. No, it is far from pleasant, indeed, it occasions much sorrow and loss. But if home-makers know about these things, they will be better able to keep their families well and save all the cost, suffering and sorrow of sickness. Look up the statistics of your city or province and make a chart, showing how many people are sick and how many die of the chief diseases.

The structure of the body. What is the unit of body structure? How does the body grow?

It is our object to learn how the health of the body may be maintained, so that we may resist disease and live happy

and efficient lives. In order to do this intelligently we must understand how the body is constructed, and how life is maintained.

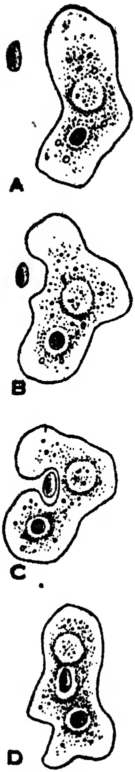

Fig. 11

The amœba taking food (as seen under a high-power microscope)

All living things are made of *cells*. They are so small that a microscope is required to magnify them before you can see them. The amœba (Fig. 11) is a tiny animal with only one cell and must perform all the processes of life for itself, much as a hermit must do living all alone in the hills.

Most living things consist of a community of cells living together, as people do in a village or city, being more or less dependent upon each other. As in an orthodox Hindu community the various castes are assigned definite responsibilities, the Brahmins preach and spread knowledge, the Vaishyas carry on trade and increase wealth, the Kshatriyas fight and afford protection, the Sudras serve and supply the means of life, and the sweepers clean and carry away the wastes, that the community may live harmoniously; so the cells of the body may be said to be divided into castes with definite work to do.

The cells of the body which have the same kind of work to do are combined to form *tissues* and *organs*; the cells of the bones support the body and provide it with levers, the cells of the muscles move the levers, the cells of the stomach and intestines digest our food, the red blood cells carry the oxygen, and the kidney cells throw out the body wastes. Each 'caste' of cells performs its special work for the whole community of cells, which we call the body. If any organ, or group of tissues, fail to do their work, the

whole body suffers, grows sick and may die. They cannot live to themselves any more than people in a community can live to themselves. Co-operation is necessary to the health of a nation as well as to all living things.

Cells differ in size, shape, colour and activity. Each cell is an individual, as every person in the village is an individual. Each cell must have food, water and oxygen, and get rid of its wastes. Here (Fig. 12) is a picture of the way a cell looks when magnified by a microscope. There is a mass of liquid substance, called *protoplasm*, surrounded by a cell membrane, and within this a small body which is called the *nucleus*. Within the nucleus is a still smaller particle, called the *nucleolus*. The nucleus is the vital part of the cell, without which no cell can live.

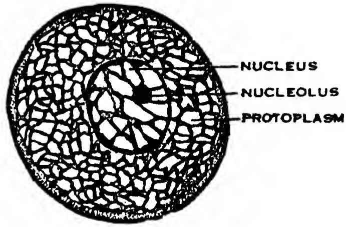

Fig. 12

Diagram of a cell, showing that protoplasm has an intricate structure; in this case it appears somewhat like honeycomb.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

As in a community people die and babies are born, so in a tissue, cells die and are constantly replaced by new ones. If more people are born than die in a community, the population is said to grow. So in the body, if more cells are developed than die, the body increases in size.

All animals, including man, are developed from a single cell termed the *ovum*. When the ovum is fertilized, it divides into two cells, and each of these cells again divides. So, by further division, eight, sixteen, thirty-two cells are formed, increasing greatly in numbers. After a time they arrange themselves in three layers. From these three layers of cells all the cells and tissues of the body are formed. The outside layer of cells forms into certain parts of

epithelium and the *nervous system*; the inside layer forms into membranes of the *digestive* and *respiratory* systems; and the middle layer develops into blood, corpuscles, *connective tissue*, *secretory* and *reproductive* organs, *bones* and *muscles* of the body. The cells not only increase in numbers, but become modified in shape according to their functions. This then is the way we develop from single cells to adult men and women.

Experiment 18. *Cells*

Peel and separate an orange or sweet lime and observe the little sacs of juice. Each is a cell. Observe the thin wall, the space between the cells. This is similar to animal cell tissue, cell walls, intercellular space and protoplasm.

Take a young onion and peel a piece of thin tissue from the root. Put on a slide and observe the cellular structure under a microscope.

Scrape cells from tip of tongue or inside of cheek, with a clean toothpick, and spread on a glass slide. Add one drop of methylene blue and let stand a minute. Carefully wash away the excess blue with water and the medicine dropper. Place a glass cover over the cells and put slide under the microscope. Observe cell walls, nucleus and protoplasm.

AGENDA

Oral and Practical Work

1. How is the body constructed?
2. How does it grow?
3. What causes it to be diseased?
4. Do you believe that disease can be prevented?
5. By what means can disease be prevented?
6. Would you like to see some of these micro-organisms? If you have a microscope you can do so.
7. If you try these experiments you can see their characteristics for yourself, and prove the means for preventing their growth.

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CHAPTER II

THE COVERING OF THE BODY

'Next after himself, man owes it to his neighbour to be well, and to avoid disease in order that he may impose no burden upon that neighbour.'—*D. Wm. T. Sedgwick.*

Required.—Knife, microscope, boric acid, salt, bicarbonate of soda, iodine solution, bandages, sweet oil, permanganate of potash.

Of what is the skin composed?

How does the skin protect the body?

When cells of one kind group themselves together, to perform one kind of work or function, they are called *tissues*. When tissues are grouped in such a way that they co-operate in doing a particular kind of work they form *organs*.

There are four kinds of tissue in the body, named as follows: (1) *epithelial*, (2) *connective*, (3) *muscular*, and (4) *nervous tissues*. Examples of all of these are found in the skin.

Epithelial tissue covers the surface of the body and lines every cavity and tube in it. This tissue is simply formed of cells packed close together and fastened with a sort of cement. It forms the outer surface of the skin, where it is known as *epidermis* and its purpose is to *protect* the body.

Under the microscope you can see that the skin is composed of two layers. The *epidermis* is the outer layer and it rests upon the *dermis* or inner layer. The cells of the epidermis are flattened and hardened on the surface and are clear and transparent like glass; but deeper down, near the dermis, they are round and soft. These cells grow and divide, forming new ones. The skin would thus grow

very thick, but that the outer layer of old cells are pushed so far away from nourishment, they die and are worn off.

Experiment 19. Scrape some dry cells from your skin and examine them under the magnifying glass.

The lowest cells of the epidermis contain minute grains of pigment which gives the colour to our skins. In all races there are a few people who have no pigment in their skins, and these are called albinos. The more pigment we have in our skins, the darker they are. Freckles are due to an increase of pigment in patches of cells.

The main part of the skin, or *dermis*, is made of *connective tissue* fibres. Among the fibres are a fine network of *blood vessels*, a fine network of *nerves*, several millions of *sweat-glands*, and a great many *oil-glands* (Figs. 13 and 14).

If you stick a pin into your dermis, what two things will happen to prove this statement correct?

The outer surface of the dermis grows into little projections called *papillæ*. Within these are found the ends of nerves and loops of capillaries or small blood vessels. The nerves of the skin are more sensitive than in any other part of the body. Their work is to tell the blood vessels when to contract and when to expand with the changes of temperature. They also tell us what we are touching.

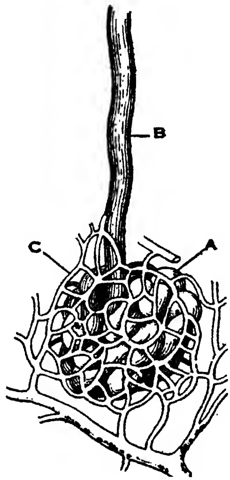

Fig. 13

Coiled end of a sweat gland and network of capillaries: A the coil, B the duct, C capillaries

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

We have now seen that the skin does two kinds of work: (1) *protecting* the body, and (2) *feeling* things. It has two other

functions of which we must learn: (1) it is one of the means of *elimination* of waste products of the body, and (2) it keeps the *body temperature normal.*

Perspiration, or *sweat*, assists in both these functions. Sweat is water which has come out of the capillaries into the sweat glands, and so on to the skin. It contains some solid matter in solution, a few scales shed from the epidermis, and a small quantity of fatty acids, fats, salt and urea. Some carbon dioxide also passes through the skin.

You can see how important it is to keep the skin clean and the pores of the skin open, so that this waste matter may be got rid of. The scales, oil and dirt form a coat which interferes with the proper functioning of the oil and sweat glands. Bathing removes this coat and helps to maintain a healthy skin. The daily bath with brisk rubbing stimulates the body and should never be neglected.

No matter in what climate we live, the heat or temperature of the body remains the same in health, that is at 98·5° Fahrenheit, or 37° Centigrade. It is the skin which helps to regulate the temperature and keeps it at normal.

The average amount of water secreted through the skin is between one and a half and two seers (1½ or 2 lbs.) per day. In hot weather, or when we exercise violently, the amount is increased. The sweat glands put out this water on to the skin, where it evaporates, making the surface of the skin cool, just as the water is cooled in an earthen *chatti* or jar, when the water oozes through the pores of the *chatti* and is evaporated. We hang the *chatti* of water in a breeze if possible, for when air is in motion the evaporation is more rapid. In order to cool our bodies we use *punkahs* or fans to set the air in motion. During the monsoon, when the air is full of moisture, the sweat does not evaporate so rapidly, and therefore we feel the heat more.

The body is always liberating heat, as you will learn

later, and when we move by walking, running or working, the muscle cells burn more food, and there is given off more heat in the body. To keep the heat constant, the skin must let more heat pass out at some times than at others. The blood circulates through the arteries in our bodies. In the walls of the arteries there are muscle tissues which have the power of contracting and making the arteries small and of relaxing to make the arteries become large again. When the body is warm, therefore, the arteries *relax* and let the blood come to the surface where it is cooled. If, on the other hand, the body becomes too cool, the arteries will *contract*, thus forcing the blood inward where it is warm and the heat cannot escape. In hot climates it is especially important to have a circulation of fresh air in the room to carry away the body heat. In a hot room the body temperature may rise above 37°C. or 98·6° F., and then you will not be able to concentrate on what you are doing, but will feel sleepy or even become ill.

Hair. Hair is to be found on almost every part of the body. It grows from a little papilla in the upper layer of the dermis, at the bottom of what is called a follicle or root (Fig. 14). A hair is really a column of tiny epithelial cells, and the only point at which it is really growing is at the root. The cut end of straight hair is round; wavy hair is oval; and kinky hair is flat.

At the sides of the hair follicles are *oil glands*, which secrete oil for the hair. When hair is brushed the oil will come out on the hair and make it oily and shiny. This is a much better practice than oiling the hair. It is not good for the hair to put the paste of 'min' on top of babies' heads, as this weakens the hair follicles. Brushing the hair makes blood come to the scalp, bringing food for the cells from which the hair grows, and strengthening it. If hair falls out, it is because the skin or scalp is tight and needs to be rubbed to loosen it and to

stimulate the circulation. Dandruff is dead skin cells matted together with oil of the head. The best cure, therefore, is regular washing daily, or at least every fortnight, with soap solution or spirits or *soap-nut*, and much brushing.

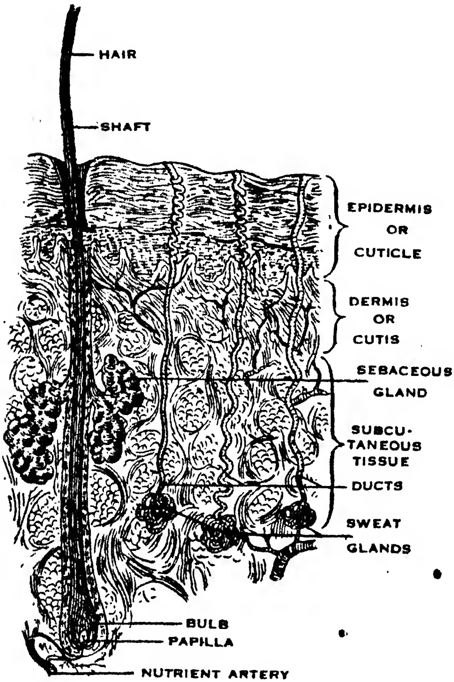

Fig. 14

Sectional view of the skin magnified. Find: oil (sebaceous) gland, sweat gland, sweat duct, hair bulb. Compare thickness of epidermis, dermis and subcutaneous tissue.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

The nails. Finger and toe nails are merely epidermis. You may think of them as wide flat hairs. They also grow only at the roots. Their work is to stiffen the fingers and aid us in picking up things. If the nails are not well cared for, we gather dirt under them. This dirt may contain disease germs. The hands need frequent cleansing, and it is a wise custom always to wash them and clean the nails before touching food or anything which is to enter the mouth.

Infections received through the skin. By what means do disease germs penetrate the skin?

How can we avoid these diseases?

Our bodies are covered by skin which is useful for protection against injury and infection. Sometimes, however, germs are able to enter the body through the openings in the skin, and sometimes we cut or break the skin, thus letting germs enter; or some insect or bug may bite us, and thus form an opening for the germs.

Pus-forming germs (Fig. 15). The dirt about us, as we know, contains many germs, and some of these which most readily enter through the skin are *pus-forming*. Have you ever had a pimple form on your skin, and then, before you knew it almost, it had grown into a *boil* or a sore? These are caused by pus-forming bacteria. The pus is really formed of dead, white corpuscles of the blood of dead body cells, germs and liquid from the blood. If this pus is allowed to get into a broken place on another part of your body, or on that of someone else, it will cause another boil. If the boil has several openings we call it a *carbuncle*. The *white corpuscles* (Fig. 16) of our blood try their best to destroy the germs, and if they are successful the sore gets well; and if the germs destroy so many white corpuscles that they spread their poisons into the blood, it results in blood poisoning. It is plain now that these germs enter the body through the skin, and in caring for a cut or wound we must therefore be careful to keep it clean, and not allow any dirt to remain in the wounds, for the dirt is sure to carry thousands of germs, and some of them may be pus-forming.

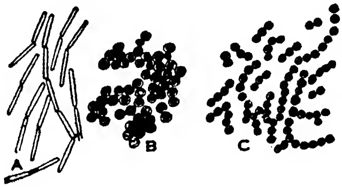

Fig. 15

Three pus-forming bacteria. A causes the bluish-green pus sometimes found in wounds; B is the most common cause of boils; and C causes erysipelas and often is the cause of boils and of blood poisoning.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Treatment. If the wound has dirt in it, wash it clean with warm salt water. (You must boil the water first to make sure there are no germs in it. Use one teaspoon salt to one seer water.) If there was much dirt in the wound you should use some boric acid, or five per cent iodine solution, to bathe it in before bandaging. Wrap the wound in a *clean* cloth, and do not remove until the wound is healed. Keep another cloth wrapped about this, so as to protect it from dirt. The outer one may be changed. The inner one is only changed if there is pus in the sore or wound.

Fig. 16

A, germ destroyed by white blood cell; B, cell destroyed by germs and the germs multiplying.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

When there is pus in a sore or boil, then the bandages must be taken off and the wound washed as before. Burn the old cloth and be very careful that the pus does not get on to your hands. Wash your hands thoroughly before dressing the wound. Use salt water, or either weak carbolic acid solution or boracic acid solution, to cleanse the sore. Boric acid ointment may be used on the dressing also. If it is a boil, you may find hot applications will soothe it and bring it to a head. The knife used in opening a boil should be *put for five minutes into boiling water* containing a trace of soda, to kill the germs on it, both before and after using it. Be very careful not to let any flies light on the sore or the bandages; for they will carry away pus germs on their legs and infect others.

Sometimes young mothers die when their babies are born, because those attending them have not been careful to

have their hands absolutely clean, or they have used unclean cloths and bedding.

Sore eyes are sometimes caused by pus-forming germs, and we need to be careful not to rub our eyes with our hands, and not to use a towel belonging to others. If your eyes are sore, drop some boracic acid solution in them twice a day.

Sometimes another kind of germ gets into wounds and this variety lives without air. If the wound is a small deep one, like that made by a nail or splinter (Fig. 17) and does not bleed much, this is the very best condition for them to grow and cause trouble. The blood does not wash them out and the wound soon heals over. In this deep wound the germs of *tetanus* (Fig. 18) multiply rapidly and *secrete a poison* which stiffens the person's muscles and causes his jaw to set, so that he cannot move it. This disease is therefore sometimes called *lock-jaw*. Old rusty nails or splinters, about a stable, are most apt to have these germs on them, for the germs are to be found in the wastes from the bodies of cows and horses. The germs are on the ground or grass, and the animals swallow them with their food. Then the germs grow in the intestines of the animals and are excreted again upon the ground about the stables. We must be particularly careful, therefore, in walking about such places not to wound ourselves.

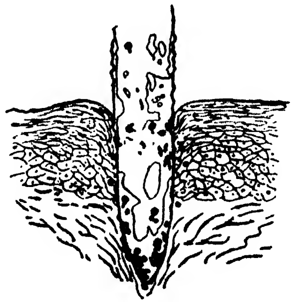

Fig. 17

If a nail or other instrument is driven through the skin, it will carry germs down and leave them among the cells.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

If you do happen to get such a deep puncture wound, you must be extremely careful to cleanse the wound thoroughly.

Open the wound and put some *disinfectant*, such as *carbolic acid* or *iodine solution*, into the wound, before tying it up in a clean cloth.

Sometimes little *new babies* die from these germs, because the nurse or doctor uses a knife, a cloth, or a salve, that is not clean, in cutting and dressing the babies' *navel cord*. This cord must be cut when a baby is born, and if the knife, or the salve with which it is dressed, or the cloth that is laid over it, has had tetanus germs on it, they will secrete so much poison that the baby will die. This usually happens about eight days after a baby is born. Don't you think you can help to spread the knowledge of how to prevent this from happening, and so save the little babies' lives? The parasites that produce certain diseases do not pass out of the body by the ordinary means of excretion, but remain in the blood.

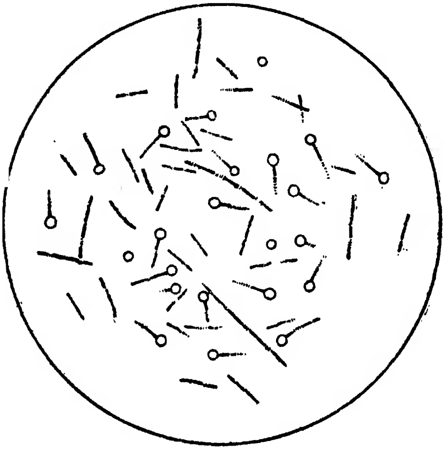

Fig. 18

Tetanus is commonly called 'lock-jaw'. It is caused by the bacilli shown here. The 'drum stick' form is characteristic of the tetanus bacillus.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Malarial fever is produced by microscopic parasites (Fig. 19) which enter the blood corpuscles, where they grow and secrete poison. They then break up into tiny spores, at which time they burst out of the corpuscles, setting free spores and poison and causing the chill followed by fever, so well known as *malaria*. Each little spore then enters

another blood corpuscle and goes through the same history as before. It takes about forty-eight hours for them to pass through this cycle of changes, and that is why we feel the *chill every other day.* Another form of the parasites take three days to repeat their history, and so the *chills come every third day* in that case.

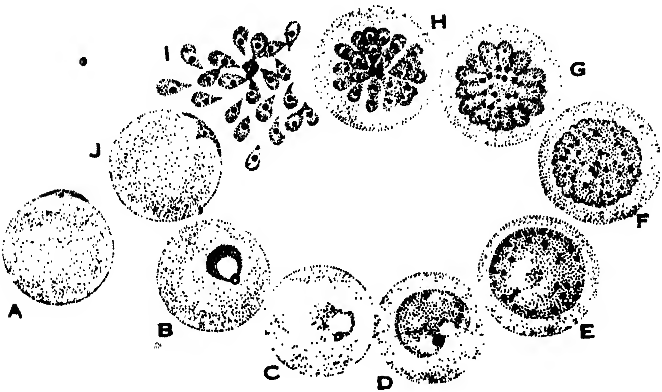

Fig. 19

Reproduction of the malaria parasite in a red blood cell. A, entering the cell; B, within the cell; C-H, development and segmentation of the parasite; I, rupture of red cell, setting young parasites free; J, one of them entering a red cell. This process goes on with continual destruction of the red blood corpuscles, until the parasites are killed by medical treatment.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

You might wonder how these diseases can be spread. It took a long time to discover the method, and brave physicians gave their lives to experiments which finally proved that malarial fever is spread by *mosquitoes*, and by mosquitoes only. Not all mosquitoes do this, but the safest thing for us, in a district where mosquitoes are prevalent, is to count them *all as enemies*, and to use mosquito netting over our beds, if we cannot screen the whole house. Copper wire screens are expensive in their first cost, but,

when we consider the cost of fever in health, happiness and efficiency, we will conclude that it is the cheapest thing in the long run. *Especially* we must *screen the sick person suffering from malaria.* When a mosquito has bitten someone with the malaria parasites in his blood, it sucks the blood into its own body. The germs can live in the mosquito's body as well as they do in the human body, but their history is different. After passing through several changes the parasites finally reach the salivary glands, near the mouth of the mosquito. Now when this mosquito, with its salivary glands full of malaria parasites, thrusts its proboscis in through the skin of a healthy person, it is sure to leave some of the parasites in the blood of the one it has bitten. There the parasites will start their life history over again, and the person that has been bitten by the malaria infected mosquito will soon feel the chills and fever. So these fevers are passed from person to person by the mosquito.

As the parasites never leave the body of the patient suffering from malaria, a way had to be found for destroying them in the body. Fortunately, it is possible to kill them by means of *quinine.* This is one of the very few diseases in which we are able to kill the germs themselves by means of medicine. Usually we can only build up the strength of the body to overcome the germs, but *quinine can destroy the malaria parasite.* One of the best ways of avoiding malaria is to take small doses of quinine during and after the rainy season, when mosquitoes are more numerous. When persons become subject to malaria, they can sometimes be cured by injections of quinine. *Dengue fever* and *yellow fever* are also spread by mosquitoes, but of different varieties. This is all the more reason why we should screen our beds while we sleep. Five-day fever is spread by sand flies. While we fortunately do not have yellow fever in India now, it behoves us to be watchful, for,

if once introduced, it would spread as rapidly as malaria, and is far more deadly.

All of you have doubtless heard of the epidemic of *plague* that we had in India in 1917-18, and will recall how many lives were lost. The germs of plague get into the body through the wounds made by the bites of *fleas.* Human beings are not the only animals that contract this disease from fleas, for both rats and squirrels are subject to plague from the same source. A rat or a squirrel with plague will have crores of germs even in one drop of its blood. Some of the rats and squirrels then begin to die of the disease, and the other rats and squirrels will leave the infested house. When the rats and squirrels die, of course the fleas leave their dead bodies, and the other fleas remain in the rats' nests. When the fleas begin to be hungry, they seek food by biting the people in the house. Now the fleas contain many plague germs in their bodies, owing to the fact that they have sucked the blood of the plague rats; as they bite the human being, they *regurgitate* into the wound the *germs of plague.* In this way people are infected with the disease.

You can see from what has been said that there is *no danger* of receiving the plague *from a patient* suffering from the disease. We can nurse and care for him with no danger to ourselves. It is the *flea*, the *rat* and the *squirrel* we have to fear. The only way to be safe from this disease is to keep our houses so clean that rats and squirrels will not make their homes with us.

Another thing that is encouraging is that the germs are easily killed by exposure to direct sunlight. Let us learn then the importance of sunning the rooms and bedding in our homes, and keeping the place so tidy that there are no hiding places for rats. We must also keep grain and food protected from rats so that they will not be enticed into our house.

If plague breaks out in your district, you should get yourself inoculated.

Inoculation is something like vaccination, for producing immunity from disease. Both anti-cholera inoculation and anti-plague sera also have been used in India with excellent results. The method of securing the sera for inoculation is similar to that used in preparing anti-toxin for diphtheria, tetanus and snake poison. The serum contains a *protective secretion* which is able to destroy the poison produced by the disease germs.

By means of a special syringe, some of this serum is introduced under the loose skin of the arm, leg or abdomen. This must be most carefully done by a doctor who knows the strength of the serum and the dose required, and who will also take care that the skin and instrument are sterilized. The body, when supplied with this protective serum in the blood, is able to resist infection from that special kind of germ.

Leprosy. This is one of the worst diseases known to man and, as it is extremely contagious, we should beware of coming in contact with anyone suffering from leprosy. When lepers are segregated in colonies they can have special care and attention. If they remain with their families, they are a menace to all with whom they come in contact.

The germ of leprosy grows so slowly that it may be several years before a person would know he had the disease. There is so little poison secreted by the germs that a leper may live many years. The germs are found on the skin, in the sores and especially in the nose of the sufferer. They are therefore apt to contaminate everything which the victim uses, and it would therefore be very difficult to attempt to destroy all the germs which come from his body.

It is equally difficult to prevent the germs from getting into our bodies. There is really only one way to deal with leprosy; and anyone who has the disease should be willing

to report it, and to go to the leper colony in order not to spread the disease among others.

Smallpox. This is a disease which is almost as dreadful as leprosy, but for which we have a certain method of control and it is the duty of everybody to make use of it. *If everyone were vaccinated, it would stamp out smallpox entirely.* What is meant by vaccination? How can such a process protect us from this most loathsome and dreaded disease? We will try to explain.

It had been known through experience for many years, that if a person had an attack of some disease, even a light one, and recovered, they were not again likely to take the disease, at least for some time. It was even the custom, years ago, for people to have smallpox given to them by a physician, after a long system of preparation, and they were then said to be *immune* if they recovered. An Englishman, named *Edward Jenner*, whose name we should always remember and honour, learned that the girls in his county who looked after the cattle had a saying that anyone who had cowpox, which was the same disease in cattle, would not be subject to smallpox. He began experiments upon this, which has resulted in giving the world, for the past hundred years, the power of protecting themselves from this deadly disease.

Perhaps you have been fortunate enough not to have seen anything of this disease; but it is so bad that when the Spaniards went into Mexico, years ago, they unfortunately took someone with them who had the germs of smallpox. Half of the population of Mexico died as a result of this. If one hundred healthy people, who had *not* been vaccinated, should visit someone who had the disease, ninety-five of them would catch smallpox. On the other hand, if the hundred people *had* been vaccinated, probably not even one would catch the disease.

Vaccination consists in giving healthy people a very

slight infection of cowpox, by means of scratching the arm with a sharp instrument, and rubbing in the cowpox germs. The skin is first cleaned thoroughly with soap and water, and then rubbed with alcohol and allowed to dry. This cleaning is to make sure that there are no pus-forming germs present. The knife or lancet must be sterilized to make it clean and dipped in a disinfectant. After you are vaccinated, do not let anything touch the part until it is dry. Then tie it in a cloth that has been boiled and dried with care. If you take these precautions it will not be very sore. If the place becomes badly swollen and sore, what would be the cause? You have learned about pus-forming germs, and they would be responsible. Look back and see how to avoid them. In Germany and in the Philippine Islands, where vaccination is compulsory, sufferers from this disease have been reduced to a very small number. Don't you think we would all be wise to have it done, especially as it does not hurt, and only makes us uncomfortable for a few days?

The body is able, when disease germs pour their poisons or toxins into the blood, to produce a substance which will counteract the poison secreted by the germs. If the body can manufacture enough of the *protective secretion* to destroy the poison which is produced by the germs, we get well. By injecting a weak variety of cowpox into the blood, the process of manufacture of this protective substance is stimulated in the body. When the body has a good supply of this protective substance in its blood, it is kept safe for about seven years from smallpox. Little children should be vaccinated, and when they are older they should have it done again. This protection against a disease is called *immunity*.

The germs of smallpox are found upon the skin and in the mouth, throat and nose. The germs make sores and, when the matter from the sores dries, it forms scabs. If

anyone in your house has smallpox, he should be *quarantined*, that is, placed in a room apart and no one allowed to go into the room except the doctor and the nurse. Everything the patient uses should be burned or boiled. Everything he touches should be wiped with a cloth dipped in a disinfectant. The dishes he uses should be kept in his room and used by no one else. Anyone nursing him must wash her hands in a disinfectant after touching the patient and change her clothes before leaving the sick room and going where she will meet others. The germs are in the scales, and anything like *salve* (or ointment) which will prevent the scales from drying and scattering, is a safeguard. I am sure you will agree it is safer and easier to be vaccinated and so avoid all this work, worry and suffering.

An affection of the skin is characteristic of chickenpox, scarlet fever and measles. These are symptoms which help to determine the disease and call for careful treatment under a doctor's advice. Anyone with such an eruption of the skin should be isolated so as to prevent him from infecting others.

Itch. You may have seen little children suffering from what we call the *itch*. As they are unable to do anything for themselves, we should do what we can to get rid of this pest for them. They cannot rest and grow strong if their lives are tormented by these little *mites*. These tiny animals are too small for you to see them. They get on the hands, and when you scratch you break the skin, and they crawl in and lay eggs. Then the eggs hatch, and so more mites spread over the body, on to your clothes, bedding or anyone you touch.

If you cannot go to a doctor or take the baby who is suffering from itch, you can do this: bathe in hot water, washing with soap where the itching is; then rub with sulphur ointment; and put on clean clothes. Keep on doing this every day, but be careful not to make the ointment too

strong for the *baby's skin. Do not scratch*, for that is the way they get under the skin.

There is another variety, known as *dhobie-itch*, which is caused by a *tiny plant* which grows in the skin-forming spores or seeds. This is harder to cure, and you should get a doctor to give you medicine, if possible. In any case, bathe daily and change to clean underclothes that have been boiled. Sprinkle over the sore places a powder made by combining equal parts of starch (corn flour), oxide of zinc, and boracic acid. Or use an ointment of carbolized zinc and cover with soft clean cloths.

Fig. 20

Ringworm fungus in a hair

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Ringworm. This is a trouble occasioned by a tiny plant or *mould* (Fig. 20). The doctor should be consulted where possible, in order to destroy this growth. The hair is apt to fall out if it gets on to the head. The sores spread in all directions from the centre, healing from the middle and spreading at the edges, thus forming a ring.

Lice. These pests, like the itch, prevent children from getting proper rest. Lice develop from long white eggs which stick to the hair and are called *nits*. They multiply so rapidly that two females would produce ten thousand in two months. There are really three kinds of lice, and the relapsing fever is said to be conveyed by the *crab louse*.

In order to rid oneself of the pests that get into the *head*, mix equal parts of sesame oil and kerosene. Smear the scalp, and wet the hair thoroughly with it. Wrap the head in an old cloth and leave the lotion on overnight. Wash the head and hair next morning in soap and warm water,

and comb it with a fine toothcomb dipped in vinegar. The vinegar loosens the nits. Cleanliness is the only way of keeping oneself free from lice.

Body lice are somewhat larger. Remove your clothing and sun it in direct sunlight. Take a bath, in which bicarbonate of soda has been dissolved (use four or five ounces of soda to a tub of water). Mix up two ounces of glycerine with one-fourth ounce of pure carbolic acid, to a seer or pint of water. Rub the body with this. To destroy the *crab louse*, use mercurial ointment, and keep the parts thoroughly clean by washing several times a day.

Injuries to the skin. The skin is also liable to damage by *burns* and *scalds*. A burn is caused by the skin coming in contact with fire, heated metal, electrically charged wire, or some chemical; a scald is caused by boiling liquid. The treatment for all except those burns caused by chemicals is the same.

If the clothing is stuck to the burn, cut it round—do not tear it off. Soak it in sweet, olive or carron oil: it will then come away. Immediately cover up the part with a clean soft rag soaked in oil or ghee, or smeared with vaseline or cold cream. If no oil or vaseline is at hand, use cloth dipped into a strong solution of soda, or wet starch, or wet flour. If there is a blister do not break it, but with a sterilized needle prick small holes in the side and drain off the liquid. If the burn was caused by an acid, then, before applying the dressings, determine the character of the chemical, neutralize by applying a weak solution of washing or baking soda. If it was an alkali burn apply a weak acid, such as lemon juice or vinegar. Any trace of the alkali should be gently removed first.

A bad burn, besides causing great pain, gives the patient a nervous shock. He should be kept quiet and warm, and given a mild stimulant such as hot coffee or, if his heart is affected, sal volatile.

What would you do if your clothes caught *fire*, or if you saw someone with her sari blazing? What does fire need if it is to burn? Deprive it of oxygen and it will go out. Therefore, roll firmly round the blazing person a ***thick*** blanket or rug or dhurrie. Do not use thin cotton cloth; it is very inflammable. If nothing is at hand, roll her on the floor. Do not permit her to run, as this causes a draught and will make the clothing burn more briskly.

A *bruise* or swelling in the skin, caused by a blow or knock, should be treated with cold water or iced dressings.

The skin is also subject to dangerous and painful poisonous *bites and stings* from snakes, tarantulas, scorpions, insects, dogs or cats. When bitten or stung by any of the above, the *preliminary treatment is the same.* The poison is more likely to enter a vein than an artery, because the veins, which are pipes taking our blood to the heart, lie near the surface, while the arteries are deep seated. You will learn more about this in the chapter on circulation. Our object is to prevent the poison reaching the heart, thus circulating and affecting the nervous system. As blood travels very quickly, the vein through which the poison will pass must be immediately closed by compression (as you might close an empty bicycle tube). This vein will be *between the bite and the heart*, therefore at once tie tightly a piece of tape or string or strip of cloth round the limb, finger, wrist, arm near elbow; or toe, ankle, leg near knee, so as to prevent the blood travelling along it. The vein should be compressed with the finger while the ligature is being prepared. It is best to tie two or three *ligatures* (as these tight bandages are called) along the limb. If the bite is on a part of the body which cannot be tightly tied, for example the neck, then press with the fingers, or with a small pad, the veins between the bite and the heart, tight on to the bone. Veins are very compressible and, if forced

against anything hard, are immediately closed. Loosen the ligature every twenty minutes for a few seconds.

Having thus prevented the poisonous blood from reaching the heart, we attend to the wound itself. If blood-warm water which encourages the flow of blood is at hand, bathe the wound freely, squeezing out the blood and with it the poison. Do not use hot or cold water; they tend to coagulate, that is, to harden the blood and prevent its flowing.

The succeeding treatment will vary according to the origin of the wound.

1. *Snake bite.* Two little red spots, where the fangs have entered, can usually be seen. Over these, *after* applying the ligature, cut with a sharp knife a small deep cross, rub in powdered crystals of permanganate of potash. Treat for nervous shock, if necessary. Take to the nearest hospital for injection of anti-venom, or smear your mouth with ghee and suck the wound, spitting out the poison.

2. *Tarantula bite.* As for snake bite. (The tarantula is a large, handsome and very poisonous spider.)

3. *Scorpion bite.* This is not *generally* dangerous, but is extremely painful for several hours. Bathe with dilute ammonia or with methylated spirits. Application of some non-burning alkali, such as a paste of bicarbonate of soda or a solution of washing soda, or a dabbing with a *dhobi's* or laundress' blue-bag, helps to relieve the pain.

4. *Wasp, bee or hornet's sting.* Like scorpions, these stings occasionally cause death to people with weak hearts. Treatment for nervous shock is sometimes necessary.

5. *Dog or cat bite.* If from a known healthy dog, treat as for wound, with iodine, lest pus-forming bacteria breed in it, and apply suitable dressing. But if there is any reason for suspecting rabies, burn the wound well, either with a red-hot wire or a flame, or with pure carbolic acid, applied on cotton wool at the end of a match, pressed

well down into all parts of the wound. Undiluted tincture of iodine may be used if nothing else is at hand, but cannot be depended on to do the work as well. Then go to a doctor. If the dog turns out to be mad, you will need anti-rabies injections known as the Pasteur treatment. Remember that saliva from the mouth, if it gets into a crack in the skin, or a scratch from the paw of a mad animal, can carry rabies as well as an actual bite, so that if you have been petting an animal that goes mad you should take the Pasteur treatment.

You will agree that the skin has a hard time protecting us from the attacks of germs, insects and accidents. You will also see how important are our laws about bathing in running water and washing our clothes and sunning them and the bedding we use, regularly. The old lawgivers knew the difficulty of keeping the body in a healthy condition in a hot climate like that of India.

We are not able to talk about every skin disease nor consider every ailment, but we have pointed out the chief ones, and if you learn the importance of *sanitary cleanliness* you will be able to protect your family and yourself from the majority of infections.

AGENDA

Oral and Practical Work

1. What are the uses of the skin?
2. How can it help to keep the body temperature normal?
3. From what harm does it protect us?
4. Why should we keep the skin clean?
5. What care does the hair require?
6. Let someone in the class pretend to have fallen and grazed her wrist. Other pupils can dress and bandage the wound.
7. What treatment must you give it to prevent growth of pus-forming germs?
8. Practise various bandages and dressings for burns, bites and stings.

9. Practise tying ligatures on an arm for snake bite.

10. Bathe the eyes with boracic acid solution : (i) using a dropper, and (ii) using a cup.

11. How can you protect yourself from malaria ?

12. What do you understand by the terms—inoculation, vaccination, immunity, contagious, quarantine ?

13. What would you do in case of fire to your clothing ?

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CHAPTER III

THE NERVOUS SYSTEM: SPECIAL ORGANS AND SENSES

'Well-being is a product of effort and resulting satisfaction. The child, without interest in work or play, does not develop; the man, with no stimulus, walks through life as in a dream.'—*E. H. Richards.*

Required.—Bandage, prism, Kodak, spectacle lens, muslin, pins, onion, mango or other fruit, spices.

How is the body controlled?

Do our nerves require care?

In India there are over 300 millions of people, divided into small groups or families. They have been compared to the millions of *cells* grouped into *tissues*. The people of India are of different nationalities and castes, and pursue specialized trades or professions, some as doctors, some as teachers, some as artisans who make our clothes and shoes, etc., or farmers who grow our foods. These specialists have been likened to our *organs*. But, as each man does not do everything for himself, it is customary for those who make things to divide and distribute their products to those who need them.

How are the manufacturers and farmers to know where their products are required unless there is some means of communication, so that any person in the country can send a message to any other person. We have messengers to carry messages, telephones and telegraph systems for sending messages, and railways to carry letters by the post. Similarly, each cell of the body is able to communicate with other cells and organs of the body. The group of

cells set apart to carry messages is called the group of *nerve cells* (Figs. 21 and 22).

The larger a community, the greater is the necessity for organization. A village organization is simpler than the

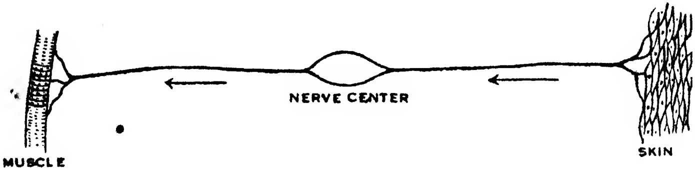

Fig. 21

Diagram of simple type of nervous system. Stimulus coming from the skin is sent by the centre to the muscle.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

city, and a city is less complex than the presidency. States, cities and villages are organized under the *Central Government*. In the same way our bodies have a central power of control, in order that all the cells may work co-operatively and in harmony. Without a government, people find themselves in a confused state of anarchy—without a central power to govern the body, there would be no harmony of action, and disease would follow, if not insanity and death. The central power of the body is located in the *brain*.

The nerve cells receive, modify, interpret and send out impulses. This means that the cells work together at the same time, and also that they co-operate as a part of a

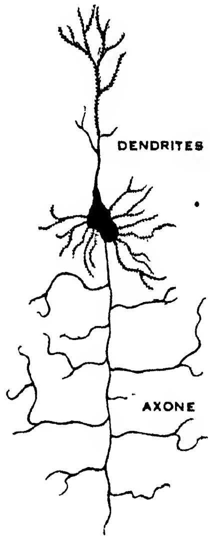

Fig. 22

Nerve cell

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

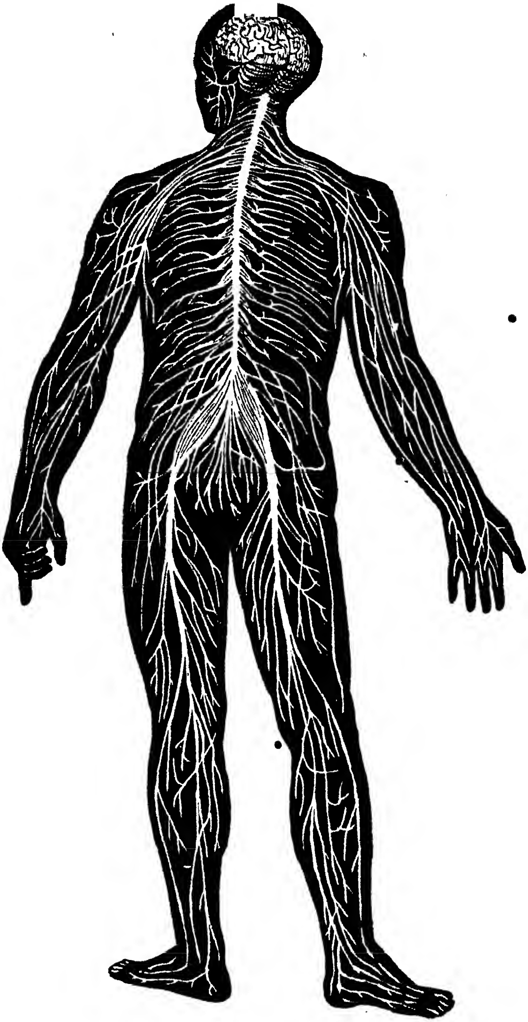

Fig. 23

The general arrangement of the nervous system (viewed from behind), showing the brain, the spinal cord and the chief nerves that branch from it.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

plan to accomplish a definite purpose. Suppose you see a rupee lying on the road. In order to pick it up, the nerve in your eye must receive the impression and pass the message on, more or less indirectly, to the muscle cells in the hand. But the muscles of the hand cannot act without the help of the muscles of the arms, legs, trunk, head and neck. So with all the impulses of the body, they require co-ordination and, therefore, there must be speedy and accurate *communication* between the cells.

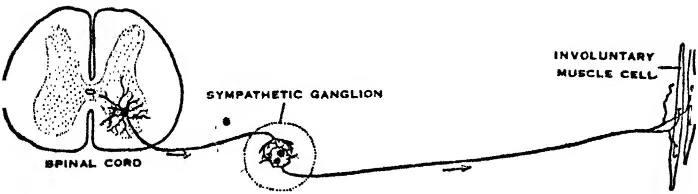

Fig. 24

In the sympathetic system the nerve impulses pass through ganglia on their way to and from the cord and brain.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

The nervous system (Fig. 23) is composed of:

(*a*) The central nervous system, consisting of the brain and spinal cord.

(*b*) The peripheral nervous system, consisting of twelve pairs of nerves coming from the brain and thirty-three from the spinal cord, which communicate with all parts of the body.

(*c*) The autonomic nervous system, whose work it is to communicate messages through the central nervous system and inner organs of the body; these messages are transmitted through masses of nerve cells called ganglia, which lie along each side of the front of the spinal column (Fig. 24).

The nerve cells are of a grey colour and it is estimated that there are more than nine billions of them in the brain,

where they are so small that eleven of them laid side by side would be no thicker than this sheet of paper, which is one-fiftieth of an inch thick.

They look something like fine sea-moss, being very irregular in shape, and have long slender fibres, finer than anything you can imagine, which spread out and interlace with other cell fibres. In the spinal cord, though, the nerve cells are much larger and have long branches leading to the hands and feet.

Many nerve fibres, bound together by *connective tissue*, form a cord large enough to be seen. Such a bundle is called a *nerve*. Fibres, that connect nerve cells with muscles or glands, are called *efferent* fibres, and they carry messages outward. Those that connect nerve cells with sense organs are called *afferent* fibres, because they carry messages inward (they are also called sensory nerve fibres). There is a third kind, called *association* fibres, because they connect nerve cell with nerve cell. *Carrying nerve impulses* is the entire work of nerve fibres.

There are so many *afferent* nerve endings in the epithelium of the skin that you cannot stick a needle in any place without causing pain; but there are not so many of them deeper down, and therefore there is less pain in a deep cut. *Efferent* nerves begin in the nerve cells of the spinal cord and end in the muscles and glands. Their work is to control motion and secretion. The messages pass more rapidly than an express train.

Nerves may become inflamed, and the disease is called neuritis (just as inflammation of the tonsils is called tonsilitis). One of the many dangers of drinking alcoholic beverages is that it may produce neuritis.

The brain is divided into three parts, called the *cerebrum*, the *cerebellum*, and the *medulla oblongata* (Fig. 25). The brain is protected from injury by the strong walls of the cranium.

The *cerebrum* is much the larger division of the brain and lies highest in the skull. It is divided by a cleft into two parts or hemispheres. The *outer* layer of the cerebrum is covered with grey matter (nerve cells), while the grey matter of the spinal cord lies on the *inside*.

The surface of the cerebrum is wrinkled and thus provides more surface for the grey matter. These folds are called *convolutions*. The inner layer of the cerebrum is

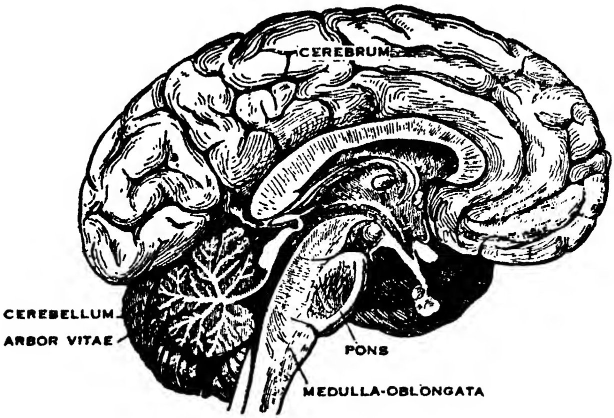

Fig. 25

Longitudinal section of the brain

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

made up of nerve fibres which connect the cerebrum with the other parts of the body. Sense-perception, consciousness, reason and the will are located in the cerebrum. The cerebrum is the part of the brain that thinks and feels; that causes us to know and to remember; to be happy or sad. It controls our power over the voluntary muscles and such sensations as those of taste, touch, sound, sight, heat and hunger. An animal without a cerebrum would have no intelligence, though it might continue to live and breathe. Like all other organs, it is dependent upon circulation,

respiration, digestion and excretion. If the heart suddenly weakens, or the arteries lose their tone, the person faints from a weakening of the circulation through the brain.

Note.—When a person faints, therefore, place the head on a lower plane than the body, so that the blood may run to the brain with less work for the heart. Free the clothing so that breathing may be easy, and open the windows to provide fresh air. Do not let people crowd around the patient. If the patient suffers collapse, that is if he becomes cold, temperature falls below normal or pulse becomes feeble, do anything you can to make him warm. If breathing ceases, apply artificial respiration. Cover the body with a blanket or coat if outdoors; if in bed, *raise the foot of the bed*, and apply hot water bottles and hot blankets.

Sometimes when a man is subjected to very great heat, as of the sun or heat from a furnace, the skin fails to respond sufficiently, and sunstroke or heatstroke is the result. The skin becomes dry and hot, the breathing heavy, the face flushed, and sometimes vomiting and giddiness occur. All clothing should be loosened and the patient laid down in a cool shady place, with *head and upper back well raised.* He should then be vigorously fanned, while ice-bags and cold water should be freely applied to his head, neck and spine. When he recovers he may drink cold water.

In both cases send for the doctor.

The *cerebellum* lies under the back part of the *cerebrum.* The convolutions branch out from the centre as a tree branches, and have been given the name *arbor-vitæ* (tree of life). Co-ordination of the muscles is carried out by the cerebellum. You *will* to walk through the activity of the cerebrum; but you control your muscles while walking through the activity of the cerebellum.

The *medulla oblongata* is also below the cerebrum, but lies in front of the cerebellum. It may be looked upon as

the most important cranial ganglia and as a part of the spinal cord within the skull. The brain acts *consciously*, the spinal cord *reflexly*. The medulla contains reflex centres and the centres of automatic action. The nerve centres, in the centre of the medulla, are the most important in the body, for they *govern the heart*, the blood vessels, and the breathing. Therefore, if the medulla is injured, the person will die immediately. The nerve fibres, going to the trunk and limbs from the cerebrum, run down in the outside part of the medulla. They cross each other in front of the medulla, from right to left and from left to right, so that the right side of the body is controlled by the left side of the brain, and the left side of the body is controlled by the right side of the brain. If the left arm is paralysed, we know it is the right side of the cerebrum that is injured, etc. The reflex centres for secretion of saliva, for swallowing and for vomiting, are also located in the medulla.

The *spinal cord* is about the thickness of your little

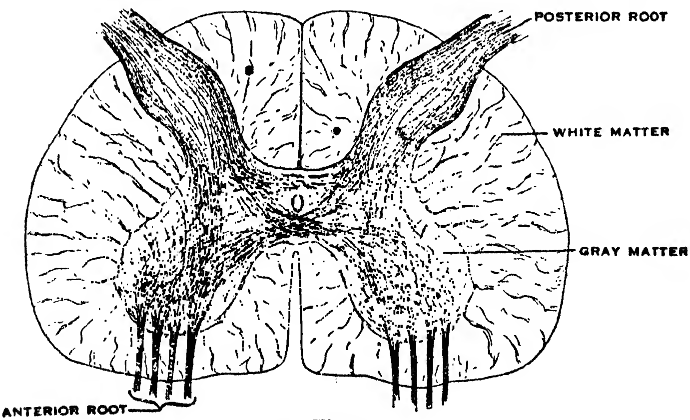

Fig. 26

Cross section of the spinal cord. Afferent impulses come in over the posterior root; efferent impulses go out over the anterior root.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

finger (Fig. 26), and it is about a foot and a half long. It is only two-thirds as thick as the canal of the spinal column through which it runs, so that it will not be injured when we bend the back. The rest of the space is filled with a liquid and three membranes which cover the cord and, with the cord, extend up through the large opening in the base of the skull and cover the brain also. These membranes are called *meninges* and, if they become inflamed, a very serious disease, called meningitis, is caused.

The brain sends impulses to the cells in the spinal cord and they in turn send the message on to the muscles. The cells of the brain and spinal cord have another important duty: they largely control what is known as *reflex* action. Sometimes it would take too long for the brain to act to protect us from injury. If anything strikes at the eye, the message will be sent to the motor nerves to close the lid, and the movement takes place at about the same time as the brain becomes conscious of the danger. We perform many acts so often that the spinal cord forms the *habit* of sending the right messages without troubling the brain about them. We chew our food and walk without thinking about each motion. Some of our reflex actions are natural and others we learn.

The formation of habits. We all love our own people and country, and we can best show our affection by becoming the best and healthiest individuals possible. We not only wish to preserve our health, but to improve the quality of life for the race. We are all aware of the close relationship between the mind and the body, for the tear ducts secrete water when we are sad and our pulse beats quickly when we are afraid. It is said that *hysteria* is due to the lack of varied and interesting work. The girl who studies at school will be all the better for helping to do the housework, and the boy for tending the garden or doing some kind of manual work. Nerve tissues become weakened

unless they are used, just as muscle tissues do. We need fresh and new sensations to keep our brains healthy and strengthen our mental faculties. If we protect our sensory nerves by wrapping our bodies in too much clothing, they will be weakened and lose their tone, causing us to take cold easily. If we eat only soft foods the nerves of the alimentary tract are not stimulated and we suffer from constipation.

However, the cells of the body cannot work without also taking some rest. When we sleep the heart beats more slowly, we breathe less rapidly, the muscles relax, production of heat is lessened and, therefore, the body needs to be protected from cold. It is only during sleep that the nervous system can completely rest. And unless we have sufficient sleep our nervous systems cannot be healthy. Little babies should sleep almost all the time, that is about twenty hours; older children require from ten to fourteen hours, and grown people from seven to ten hours. Sleep is necessary for the growth and repair of the cells and, therefore, it is important that it be secured under right conditions. By going to bed at the same hour every night, the habit of sleep is established. It is important, too, that our minds be in a happy or at least cheerful state. The room should be cool and well ventilated. Some people have a fear of night air and close everything up tight, and then they wrap their heads up so that almost no air can reach them. No wonder they feel tired and discouraged next day. If there is any danger of robbers, let us bar the windows so that they may be kept out and the air be allowed in. If mosquitoes attack us in the night it prevents sound sleep, and also they are likely to give us malaria. Beds that swing from the ceiling are airy and good, and if a mosquito net is arranged around them we can sleep comfortably and will arise refreshed. The custom of taking part of our sleep during the heat of the day is a good one. It is better to get up early and do

our work in the cool of the day than to work through the heat; and the sleep we get during the day is just as good as the sleep we take at night.

Pain or irritation will prevent the body from gaining the refreshment it requires. Headache is perhaps the commonest form of pain. The cause may be over-eating, indigestion, over-work, lack of exercise and fresh air, eye-strain, or general weakness. Whatever the pain you suffer, you should seek the cause and have it removed, for pain is Nature's way of telling you that there is need of attention to that part. The nerves cannot rest if they are being disturbed by pain. It is even worse to take opium to dull the pain, for this deadens the nerve cells and prevents the other cells from working to repair the trouble. Opium, morphia and cocaine cause a large proportion of insanity, and alcoholic insanity may be caused by even moderate amounts if used regularly. These poisons make up the largest part of many patent medicines, and this is a good reason for not taking medicine without the doctor's advice. Opium and alcohol seem to start by attacking the nerve centres, beginning with the highest. The will-power and judgment are first deadened, and only the emotional and impulsive instincts are left. As these are no longer controlled by the reason and judgment, the person acts irrationally. Finally, consciousness and power to act are lost, and only the medulla, governing the circulation and respiration, is active. Large quantities of these drugs may produce death by paralysing these nerve centres. The use of tobacco, though not so disastrous as that of opium, has also a bad effect upon the nerves, especially of young people. Those who use drugs continuously, finally destroy the nerve tissue.

Worry is one of the chief causes of sleeplessness and a disturbed nervous system. The fear of disease or the loss of friends and relatives, makes us very unhappy. How important, then, it is for us to learn how to prevent unneces-

sary sickness and death. Another great cause of worry is debt. We incur debt for caste dinners and marriage feasts, and place ourselves and our family in a position to worry over the payment of heavy interest for years to come. Avoid debt as you would the plague.

When we perform an act so often that we do it without thought, we have formed a *habit*. We are all of us very largely 'bundles of habits', and it is very important that we form the right habits while we are young. That is what your parents and teachers are endeavouring to do—to train you in 'right habits of action and tendencies to behave'. We form habits by doing a thing repeatedly. You cannot help forming habits, and if you do not form good habits you will be forming bad ones. It is difficult to overcome bad habits, but it is easy to keep them out in the first place. Good habits are our friends and bad ones our enemies. We will learn in this book about some of the habits necessary for good health. Let us acquire these habits, and so become strong and healthy.

Habits are formed by doing an act repeatedly and regularly. If we lapse even one time, it breaks the formation of the habit. To try to form a habit, by doing a thing one day and omitting it the next, would be like trying to climb a stair by taking one step up and the next one down. Do you think you would ever reach the top? The older we are the harder it is either to make or break a habit. The way then to form right habits is always to do the thing in the right way. What are some of the habits we should form in youth to keep us healthy?

1. *Sleep* long quiet hours, with the windows open. Go to bed at a regular hour. Do not cover the head with a cloth. Keep the mosquitoes away by screening the windows and doors, or have a net over the bed. Learn to relax.

2. *Rest* your mind and body by keeping calm and overcoming fear and worry. Change of occupation is rest.

3. *Exercise.* Spend as much time as you can out of doors, walking and playing games. Hold your body in a correct posture, whether you are standing, walking or sitting.

4. *Air.* Breathe deeply of pure, clean air at all times. Keep the windows open.

5. *Sunshine.* Let it shine on you for a short time daily; but avoid over-exposure.

6. *Water.* Drink at least three seers (three pints) of clean, boiled water daily.

7. *Baths.* Bathe each morning when you first get up. Wash the hair at least every fortnight. Clean the nails regularly. Wash the hands before eating.

8. *Food.* Eat a variety of good food at regular meal times. Three meals a day are enough. It is better to eat a little at three meals than a great deal at one meal. Chew your food thoroughly.

9. *Teeth.* Brush the teeth at least once a day, and rinse the mouth after eating and at night before going to bed. A piece of fruit after a meal will help to cleanse the teeth.

10. *Bowels.* Be sure that your bowels move at least once a day.

11. *Study.* Keep your mind upon good thoughts. Learn to concentrate when you study so as to *make the ideas yours*, and not just 'to pass' an examination.

The special senses.

How do we feel, taste, smell, and hear?

What care of your ears and eyes is required?

Sensory nerve fibres carry messages to the brain, telling it that we are hungry, thirsty, sleepy, sick. These are *general sensations*, coming, as they do, from all over the body. But the nervous system has produced certain groups of cells for carrying particular messages to the brain; they come from certain parts of the body and are called *special sensations*. The eye has developed so that we may see the

world about us. The ear has grown in a definite way so that it can receive *sound.* The nose receives sensations of *odour*, and the nerve endings in the mouth receive the *taste* sensations. These organs, which have in them the nerve endings for these special sensations, are called *sense-organs. Seeing*, *hearing*, *smelling*, *tasting* and *feeling* are called the *five special senses.*

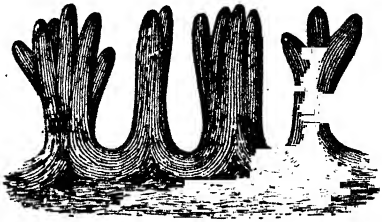

Fig. 27

Four papillæ of the true skin, magnified. The epidermis has been removed. Most papillæ contain touch corpuscles.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Touch. The sensory nerve endings in the skin have special work to do (Fig. 27). Some receive the sensations of cold, some of heat, and others of pressure and pain. We can feel most sensitively at the tip of the tongue and with the lips. The fingers are far more sensitive than other parts of the body, and the back is least sensitive of all. When we touch anything the message is taken by the nerves to the brain, and it is the brain which decides whether the object is rough or smooth, hot or cold. The sense of touch lies in the epidermis.

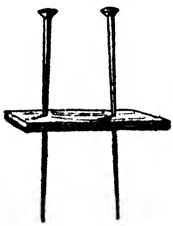

Fig. 28

Pins in wood

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Experiment 20. *To test your sense of touch* Tie a handkerchief over the eyes of one of your class-mates. Put pins through a piece of wood and touch different parts of her body (Fig. 28). Sometimes put one pin, and at other times put two or three pins through the wood. See how far apart the pins must be before the girl can tell how many pins there are. Try this on different parts of her body and on your own body.

Taste. Our sense of taste can distinguish only acid, salt, sweet and sour. In order to taste things they must first be dissolved on the tongue. The top of the tongue is most sensitive to sweet and salt. The back part of it is most sensitive to bitter tastes, and the sides to sour. There are little *taste-buds* in the skin of the tongue and back part of the mouth (Fig. 29). When food is dissolved it goes down into the little hairlike cell endings at the mouth of the taste-bud, and the nerves send messages about the taste to the brain. What are called flavours, however, affect us through the sense of smell. Taste and smell act upon the salivary and gastric glands, and greatly influence digestion.

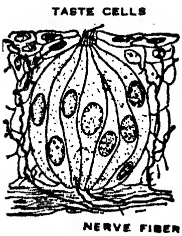

Fig. 29

A taste bud

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Experiment 21. *To test whether taste affects us through the sense of smell*

Try the experiment of holding your nose shut and get someone to blindfold your eyes; wipe your tongue dry and put different foods on your tongue — onion, apple, mango — and see if you can distinguish which is which.

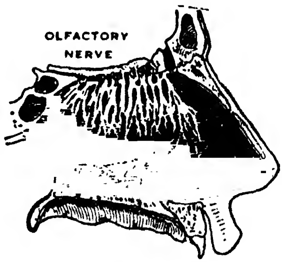

Fig. 30

The olfactory nerves

(From *Human Physiology*, by Dr., J. W. Ritchie. World Book Co., New York, 1913.)

Odour. Little molecules are constantly rising from things which have odour. When they are sniffed up into the nose we can smell them. Special cells in the upper part of the nose are called the olfactory cells, and the nerve of smell the *olfactory nerve* (Fig. 30).

The nerve endings are hairlike and, when the tiny molecules of odour come up into the nose, they touch these

cilia-like ends, and the nerve then takes the message to the brain. We would do well to cultivate our sense of smell, both for its pleasure and also as a means of warning us that the drains need attention. Just as pain is sent to warn us that the body needs attention, so bad odours should stimulate us to see that the cause of them is removed. We grow so accustomed to these foul odours that we neglect them, to the detriment of our health. Nasal catarrh, a chronic cold in the nose, accompanied by the formation of phlegm, and producing a stuffed-up feeling, is generally caused by the nasal passages becoming partially blocked, and encouraging the continual growth of germs. A physician should be consulted, and the obstruction removed. If an insect should get up the nostril, or some hard object be pushed up by a child, make him sneeze and blow his nose hard.

Experiment 22. *To test the acuteness of smell*

Try the game of tying up various spices, etc., in little pieces of cloth. Number them and number the packets with the name of the article opposite. Keep the names secret from the class. Pass the packets around and let each make a list of the numbers, with the name which they think describes the odour. When all are ready, exchange papers and read out the answers. See who has distinguished most odours correctly.

Hearing. Did you ever watch the little waves that spread from the spot where you throw a stone into the water? The stone strikes the water and the little molecules moving cause the waves of water. In the same way a sound is made by striking a drum. The vibration of the drum-head sets the air molecules in motion, and causes waves of air to move like the water waves, until they strike the ear; then the nerves of hearing carry the message to the brain, and the messages make us hear. The work of the ear is to collect the waves of sound and carry them to the *auditory nerve* which is the nerve of hearing.

The ear (Fig. 31). The ear is a wonderful instrument with three parts: the outer, the middle and the inner ear. The outer part is made of cartilage and is what we call the ear. Its work is just to catch the sound waves and pass them on to the middle ear. The entrance to the ear is guarded by hairs and its walls covered by a bitter wax to protect the ear against insects. We should not dig into our ears with anything hard to try to remove the wax. A cloth on the end of your little finger goes in as far as it is safe to do. If wax hardens, it should be syringed out with warm water; but it is better that this should be done by an experienced person, a doctor or a nurse. Hard objects, such as children sometimes push in their ears, should *not be touched* by anyone but a physician. Insects may often be floated out by pouring warm oil in the ear.

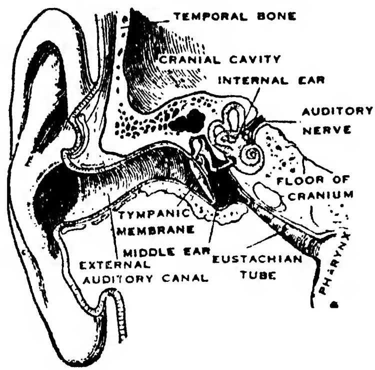

Fig. 31

The ear

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

At the bottom of the canal is a skin-like membrane, called the *tympanic* membrane, separating the outer from the middle ear, which is sometimes called the ear-drum. There are three little bones in the middle ear, called the *hammer*, *anvil* and *stirrup*. The hammer (*malleus*) is fastened to the tympanic membrane, and the stirrup (*stapes*) is fitted into the opening of the wall dividing the middle from the inner ear. The anvil (*incus*) is attached to each of these bones, making a chain across the middle ear. The middle ear has air in it, and there is a passage from it to

the throat, which permits air to enter the middle ear, and so keep the pressure of air on each side of the tympanic membrane equal. This tube is called the *eustachian tube* (Fig. 32). Sometimes, when blowing the nose, the air is

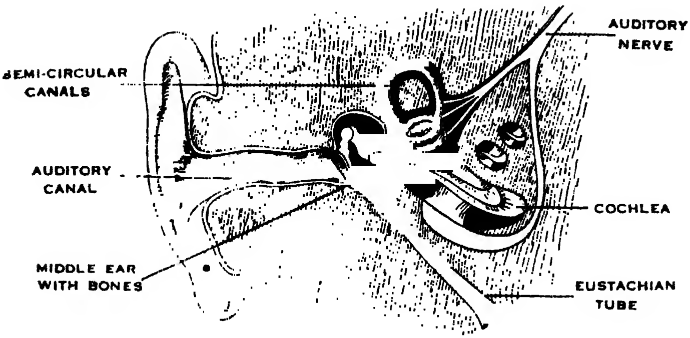

Fig. 32

Diagram of ear and eustachian tube

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

pressed up into the middle ear, compressing the walls of the tube together, causing deafness. To relieve this, hold your nose and swallow.

The inner ear consists of several cavities containing a liquid in which rest the endings of the auditory nerve. There are three parts to the internal ear (Fig. 33): the front, or *cochlea*, is shaped like a conch shell; the back consists of three *semi-circular canals* which open at both

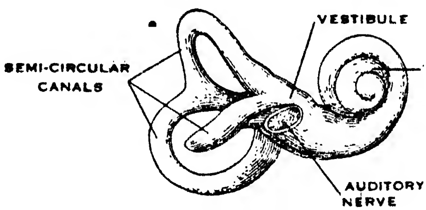

Fig. 33

The inner ear

(From *Healthful Living*, by J. F. Williams. The Macmillan Co., New York, 1921.)

ends into the central part called the *vestibule*; and there is a little hole in the vestibule, with a thin film stretched across it, in which the stirrup (stapes) fits.

Now we are ready to understand how we can hear sounds. The external ear catches the air waves and passes them down to the tympanic membrane. The waves cause the membrane to vibrate and so moves the hammer; the hammer hits the anvil, and the anvil strikes the stirrup. Then the stirrup pushes into the inner ear, making waves in the liquid there. The waves in the liquid then stimulate the nerve cells and cause the nerve to take a message to the brain, and so we hear a sound.

Deafness is a serious handicap to one suffering from it. One of the commonest causes of deafness is nasal catarrh. The germs flowing through the nasal passages to the throat enter the eustachian tubes leading to the middle ear, and sometimes cause chronic inflammation there. A pain or discharge from the ear, or a feeling of deafness, should never be neglected. Get the doctor's advice and follow it.

Experiment 23. *To test keenness of hearing*
Set up a clock in a quiet place, and find out at what distance you can hear it tickling, first with one ear, then with the other. Close with the finger the ear not being tested.

It is believed that the *semicircular canals* do not have anything to do with our hearing, but are concerned rather with what is called our *equilibrium sense.* The movement of the liquid in them causes the nerves to bear messages to the brain, to tell in what direction we are moving and to help us to hold the body upright.

The eye. Blind people have to rely upon the sense of touch to distinguish the form of an object. Some have such delicate touch that they are able to do almost everything that a person with good eyes can do; but, though they even learn to read with the fingers, it is impossible for them to see colour or movement. The sense of sight is a wonderful

gift, and we should take every care of the eyes that have this marvellous power of taking pictures of the world about us and carrying them to the brain.

The eyes are protected by the bony sockets in which the eyeballs lie, so that they cannot easily be hit, and the balls rest upon beds of fat, which act as protective cushions. The eyebrows prevent sweat from running into the eyes; the eyelids and lashes help to keep dust from getting in, and too strong a light from striking the eyes.

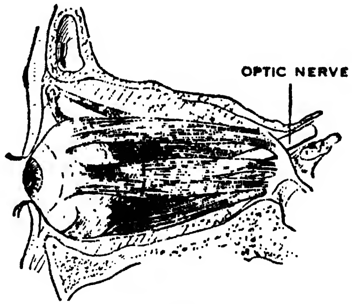

Fig. 34

The muscles of the eye

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

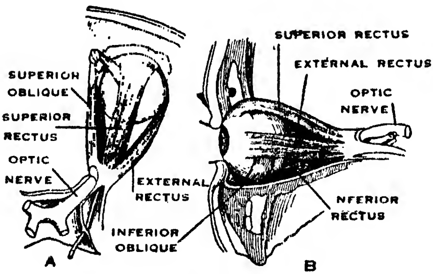

Fig. 35

A, the muscles of the right eyeball (viewed from above); B, the muscles of the left eyeball (viewed from the outer side).

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

The eye is controlled by six muscles, called the *oculomotor* muscles (Figs. 34 and 35). Four of them are straight; one of them turns the eye upward and the other turns it downward. One turns it inward, the other outward. Two are oblique and rotate the eye in opposite directions.

The surface of the eye is kept moist by a fluid secreted by the *lachrymal* gland, under the outer and upper part of the eyelid.

This fluid runs across the eyeball and down into the nose, through a little opening called the *lachrymal duct*, and in this way the eyeball is kept clean. When we weep, the fluid overflows and runs down the cheeks in tears. There are glands also under the surface of the lids in the *conjunctiva* (lining of the lids), which produce an oily secretion which prevents the eyelids from becoming dry. Sore eyes (*trachoma*) is a disease of the *conjunctiva* and is very infectious. It must be attended to, or you may lose your sight. Another eye disease is called *pink eye*. Always use your own individual handkerchief and towel, so as not to get an infection of sore eyes. These diseases can be cured if taken in time; therefore, consult a doctor at once.

The eyeball is a ball filled with transparent fluids (Fig. 36). The interior of the eye is divided into two compartments by a semi-solid substance called the *lens*, which is

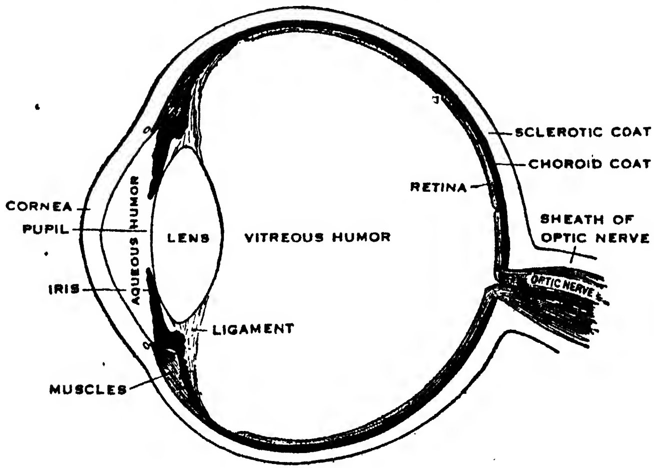

Fig. 36

A diagram of a section of the eye

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

capable of focussing rays of light, and a muscular diaphragm called the *iris*. The window in the iris is called the *pupil*, and behind it is the *retina*. The wall of the eye is made of three layers of tissue called *coats*. The outside coat is hard and tough and is named the *sclerotic* coat. It holds the shape of the eye and is white, excepting in front, where it is transparent and is called the *cornea* or window through which we look. The middle or *choroid* coat is made of pigment cells and blood vessels. It does not completely cover the eyeball, but turns back at the beginning of the

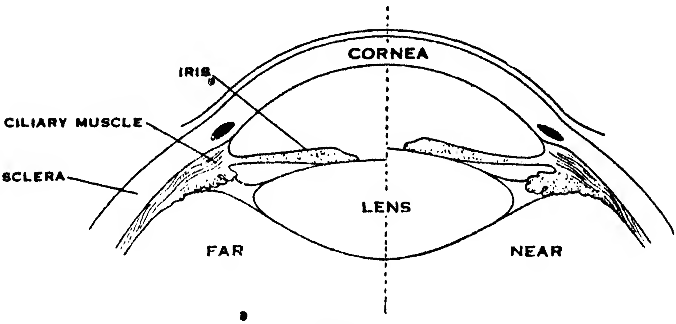

Fig. 37

Diagram to illustrate accommodation

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

cornea and forms the *iris*. The iris has an opening called the *pupil*, and it can change in size because of tiny muscles, which open the pupil just enough to allow the right amount of light in to stimulate the *optic nerve*. When the light is dim the pupil is open wide, and in bright light it is contracted to a small opening, just as you adjust the shutter in the camera according to the light. These two structures, the iris and the lens, divide the chamber of the eye into two compartments. In the front chamber is the *aqueous humor*, or water-like fluid, which gives firmness to the front of the eye and allows the light to pass through without deflecting

it. In the back chamber is the *vitreous humor*, or glass-like liquid, which entirely fills it.

The *lens* (Fig. 37) is a circular sac, filled with a jelly-like substance which is transparent, so that the light can go through it to the back of the eye. It is held by ligaments from the choroid, at the place where the iris begins. The work of the lens is to make pictures or images (Fig. 38) of the things we see on the retina.

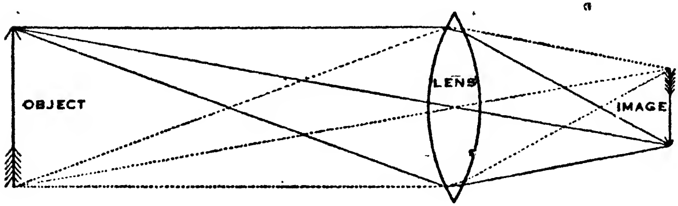

Fig. 38

Image formed by a convex lens

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Experiment 24. *To see how the eye lens acts*

Take a lens from your grandmother's spectacles and hold it up on the side of the room away from the window, and catch the image of the window on a piece of white paper held back of the lens. This shows how the image of an object is formed by the lens on the retina.

A Kodak, if available, should be examined to see how the lens reflects an image.

To make a clear picture of a *near* object, the lens must be more rounded than to make a clear picture of a *distant* object. This change in shape is brought about by little muscle fibres around the lens. The change in shape of the lens is called *accommodation*. You strain the muscles if you look at very near objects; therefore, we must take care to hold our book at the proper distance from the eye, that is, from fourteen to eighteen inches. You should have a good light falling on the book, from behind, over your left

shoulder. If you must face the light, then shade your eyes. Hold the head up when using the eyes, and do not try to read by a dim light. If your eyes tire, rest them by looking away from your work to a more distant object.

The *retina* is the third and inner most layer of the wall o the eyes, and lines the chamber. It is composed of the end filaments of the *optic nerve*, of which there are more than a hundred thousand. The work of the lens is to make the picture on the retina. The work of the retina is to receive the picture, and the work of the optic nerve is to carry the messages to the brain about the pictures. In this way we see.

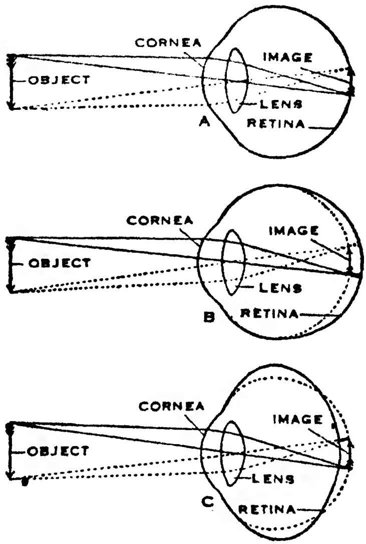

Fig. 39
A, normal; B, near-sighted; and C, far-sighted eye.
(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Experiment 25. *To analyse sunlight*

Throw the rays of the sun after passing through a prism upon a sheet of paper. Note the colours of the paper. Note the colours of the spectrum present.

Some people may have what we call *near-sight* and others *far-sight*, and it is necessary for them to wear spectacles to prevent straining the eyes and to help them to see better. Often headaches and nausea are caused by straining the eyes. An oculist should be visited, and glasses secured to correct the faulty vision. Near-sighted people need glasses that are *concave* (hollow surfaces), and far-sighted people require *convex*

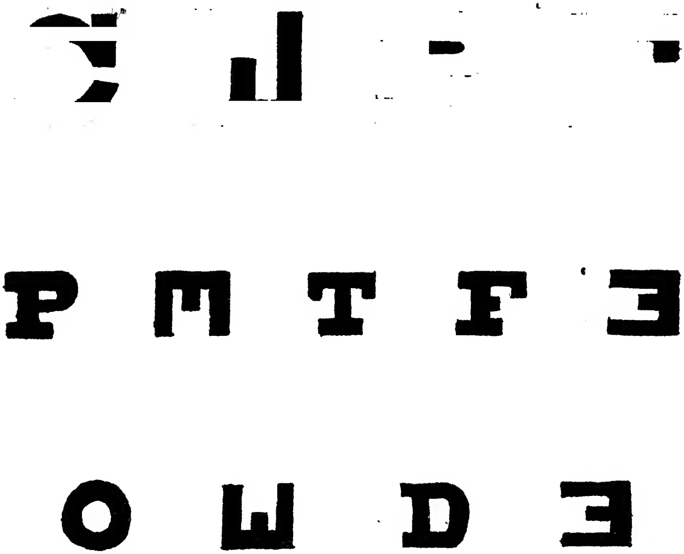

Fig. 40

To test your vision

glasses (rounded out surfaces) (Fig. 39). Do not try to fit yourself with eye-glasses, but go to an oculist.

Experiment 26. *To test your sight*

You should be able to read the upper line at a distance of 30 feet, and the two lower lines at a distance of 20 feet. If you are not able to do this your eyes require glasses. (Ask the child whether the letter is open at the right, left, top or bottom.)

In a hot, sunny climate it is wise to protect the eyes from the direct rays of the sun, and for this purpose hats with a brim or solar-topis are better than the little velvet caps so much worn by boys. Girls should carry sunshades. Dust, too, is bad for the eyes by irritating the eyelids, and also by carrying germs that will make them more sore. The eyes of babies need care. Wash the eyes with either

warm or cold *boiled* water. A half-teaspoonful of purified salt, in a half seer of water, is good to wash the eyes in. A little boric acid dissolved in water and dropped into the eyes, twice a day, is good for inflamed eyes. Or the eyes may be washed by laying them close to the surface of the water and bathing the lids. Eye-cups may be obtained for this purpose.

Small insects or grit, fragments of cinders, get into the eyes, especially when travelling. If you can see the object in a mirror, it may be removed with the corner of a clean handkerchief. If there is someone to help you, let them roll the eyelid back over a pencil, and then they can see the object more readily. If you cannot see it, try taking hold of the upper lashes, and pulling the lid down over the lower. Roll the eyeball around and around to dislodge the object. Then blow the nose hard, closing the nostril on the opposite side. Wash the eyes out as above prescribed.

AGENDA

Oral and Practical Work

1. What is the work of the nerve cells?
2. Why should a fainting person be placed with the head lower than the feet?
3. If the unconscious person is *red* in the face, why should his head be raised?
4. Practise on one of your class-mates the method of giving first aid in case of fainting.
5. What is habit?
6. How many steps do you take in going up the steps of your home?
7. How is it that you take these steps frequently and yet do not know how many?
8. What other things do you do habitually?
9. How do you take a stitch in sewing?
10. Are you conscious of which foot you put first into a shoe?
11. Do you have to give attention to each bite you take in eating?

12. What are the effects of such *bad* habits as taking opium, alcoholic beverages and tobacco?

13. How can habits be formed? How can they be broken?

14. Is it easier to avoid forming such habits, or to break them once they are formed?

15. Make a list of the *good* habits you possess.

16. What new *good* habits do you intend to form?

17. Why do we hear better when we put our hand behind the ear?

18. What is the danger from pushing any hard instrument or object into the ear?

19. How do the ears help to maintain our posture?

20. What sensations of taste are received by the taste-buds?

21. What part do the eyes and nose play in relation to taste? Try experiment.

22. What is the correct sitting posture in relation to light, for reading and work?

REFERENCES

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CHAPTER IV

THE MUSCULAR SYSTEM AND BONY STRUCTURE OF THE BODY

'The office of the home must be to teach habits of right living and daily action, and a joy and pride in life as well as responsibility for life.'—*E. H. Richards.*

Required.—Segri, charcoal; chicken-leg bones, strong vinegar or weak sulphuric acid; book, sheet of notepaper, foot-rule.

How is the body able to move?

How can we develop our muscles?

Muscles and bones *are necessary to move* the body, but what it is that really starts the impulse to *make* the body move is as yet beyond the scientists to state. The complete story of what happens when you walk or lift your arms is too intricate for you fully to understand.

The story begins, as all the wonderful things about the body do, with the life of the tiny cells of which we have talked. Some muscle cells elongate and are called *fibres.* Let us first consider one of the fibres, which is shaped like a slender cylinder. If you could lay five of the larger ones side by side they would measure no more than the thickness of the paper upon which this book is printed. The fibres are several hundred times as long as wide, and if we were able to lay one out by itself an inch long, it would be invisible, because of its slenderness. If we could magnify this 500 times, until it was fifty feet long, it would then be one inch wide. Then, if you looked very closely, you would see that the fibre was *banded* in layers, each less than a thirty-second of an inch, looking like alternate light and dark discs. These are called striped or *striated* fibres

(Fig. 41). There are at least half a million of these tiny fibres in a muscle like the biceps of your arm, which helps you to lift it. They are wrapped in bundles of about two thousand by a delicate web, and they are filled and surrounded by a *syrupy fluid.*

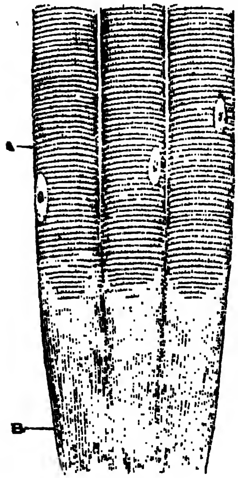


Fig. 41

Striated muscular fibers A terminating in tendon B. Many other fibres would attach to this tendon.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Alongside each tiny fibre lies a *capillary*, in which runs blood which carries fuel and oxygen to the fibres. There are tiny *nerves* attached to each fibre, spreading along one side and fastened to the fibres at numerous places. These little nerves bring the message to the fibres, telling them to *contract* when you wish to lift your arm. When the ten thousand fibres contract at one time, it makes the fibres slightly shorter, and when the sixty lacs of them shorten at the same time, it makes the muscle shorter, and when the six billions act simultaneously you lift your arm. If any of them were unwilling to co-operate you see how difficult it would be to move the body. In every fibre is stored a substance, made out of sugar, which the blood brought to it. When the fibres set to work they change this substance and produce acid. This acid acts upon the fibres and causes them to contract. Then it is oxidized and heat is produced.

The muscles of the arms and legs are moved according to our will and are therefore called *voluntary* muscles, and all muscles of this kind are made of striated fibres such as we have been discussing. *Muscle tissues are found in nearly every organ*; the stomach is made to contract by muscles

in its walls, and so the food is mixed; muscles in the intestines keep the partially digested food in motion. The walls of the blood vessels have muscles which help to circulate the blood. But these muscles are composed of fibres differing from the striped or striated muscles. They are shorter and are not striped but *plain* (Fig. 42). They are shaped like a spindle with pointed ends, while the ends of the striated fibres are blunt. The muscles composed of *plain fibres* are called *involuntary*, because they cannot be moved at will. The muscles used in breathing are *striated*, and those of the heart are different from either, having some characteristics of both.

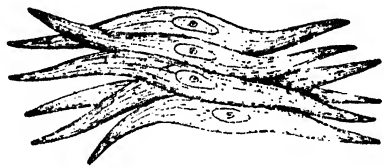


Fig. 42

Fibres of non-striated muscles or involuntary muscles

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

A delicate web, called *connective tissue*, binds the fibres together into bundles, and especially strong connective tissue extends from the end of such a bundle, thus forming what is called a *tendon* (Figs. 41 and 43). These tendons are fastened to a bone and are so strong that one no larger than your little finger would hold a weight twice that of your body. Some muscles have tendons at both ends, some only at one end, and some have none, these latter being fastened directly to the bones. Can you feel the tendon on the inside of your elbow?

The *involuntary* muscles are usually found in the walls of the organs which have cavities and, because we call these organs *viscera*, these involuntary muscles are also called *visceral muscles*. The *voluntary muscles* are usually attached to the bones and are therefore called *skeletal muscles*. There are about 500 of these.

Let us look at the charts showing the muscles of the body and see if you can pick out the voluntary muscles (Figs. 44 and 45). You will notice that the middle part is usually large and thick, but that they taper to small cords at the ends. If the large part of the muscles extended down into the hand and foot, you can imagine what big awkward things they would be. See now if you can find muscles without tendons.

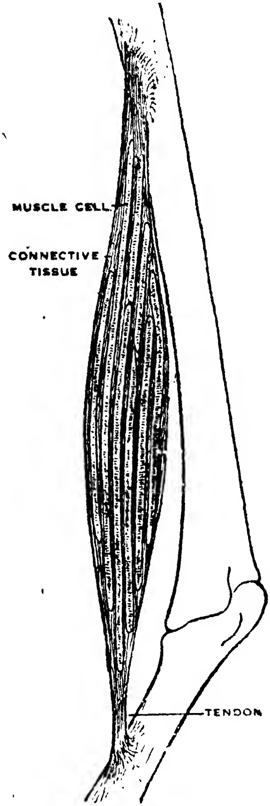


Fig. 43

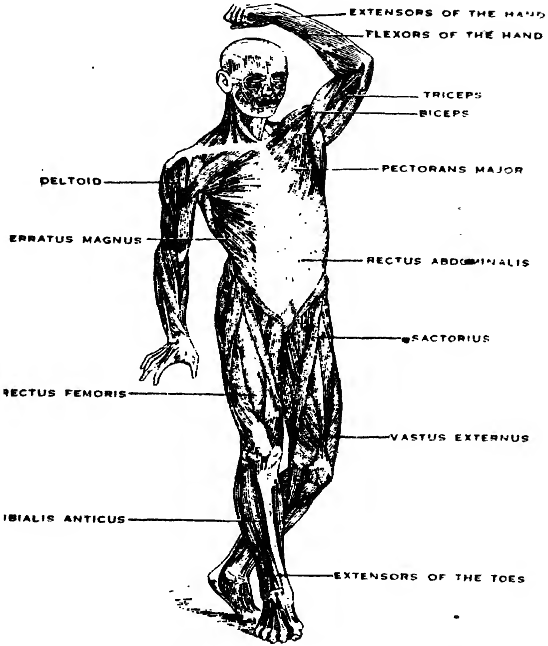
Diagram showing how the connective tissue passes through a muscle from bone to bone. The muscle cells are shown many times larger than they would actually appear.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

You will soon learn that the bones are covered with a network of connective tissue fibres called the *periosteum*, and these fibres are the means by which connective tissue fibres of the muscles and tendons are able to attach themselves to the bones. They spread over the surface of the bone and weave themselves in and out of the periosteum.

The *connective tissue* holds all parts of the muscle together. All through the body the connective tissue runs, holding the cells, organs and tissues in place.

Now I think you will be able to see how the parts of the body move. We said at the beginning that the muscle fibres and, therefore, the muscles can *contract*, that is, they can become shorter and thicker. When the muscle



44 Full-figure muscles (front)

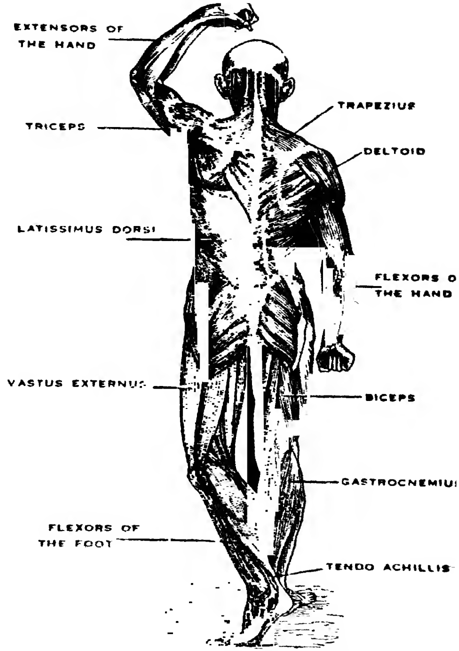


Fig. 45. Full-figure muscles (rear)

(From *Healthful Living*, by Dr. J. F. Willia e Macmillan Co., New York, 1921.)
The names of muscles are gi need not be learnt.

fibre becomes long again, it is said to *relax*. If one end of the muscle is attached to the end of a bone and the other end to another bone and if this muscle contracts, it will pull the bones together. This makes your skeleton bend at the joints. Place your right hand upon the *biceps* of the left arm (Fig. 46). Now bend the left arm and see if you can feel the muscle contract. Boys like to show how big they can make their biceps by strongly contracting them.

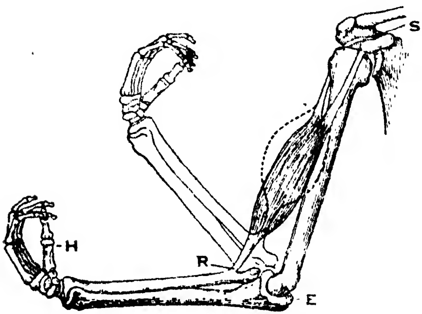


Fig. 46

Diagram to show the action of the biceps muscle of the arm. The two tendons by which the muscle is attached to the scapula are seen at S; R, the point of attachment of the muscle to the radius; E, the elbow joint; H, the weight of the hand.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

All the movements of the body are made by the muscles pulling the parts of the body in this way.

Our muscles are most of them arranged in pairs. We know the biceps which we use for bending the arm, and on the back of the arm is another muscle called the *triceps* which will pull the arm straight again. One muscle will close the finger and another will straighten it again. So, all over the body, the pairs of muscles act *antagonistically* to each other. Our muscles must work together if we are to do anything well, from threading a needle or throwing a stone to standing correctly. This working together of the muscles, by aid of the nerves, is called *co-ordination*. When baby sleeps you know how limp it becomes, and if you try to make it sit or stand, it bends at all its joints and drops down again. This is because its muscles are *relaxed*. Some of the muscles must always be contracted to keep us erect. In

the act of moving, of sitting or of standing, *contraction* of the muscles is necessary.

Some people, on account of worry or over-active desire, keep their muscles drawn *tense*, and the antagonistic muscles pulling against each other, until finally they lose the power to relax. Their movements are nervous and jerky, they cannot keep still, their voices are unsteady. Such people do not even relax when they go to sleep.

This is a very different condition from the slight contraction which is called *tone*. It is this slight contraction which makes a wound gape open when the flesh is cut. We become flabby and soft when our muscles lose their tone. *Good posture* depends a great deal upon tone. We must keep the abdominal muscle in good tone, or our abdominal wall will become flabby and relaxed (Fig. 47).

The diaphragm (Fig. 48) is another important muscle, as you will learn when you study breathing.

If the pelvic muscles lose their tone it leads to many troubles to which women are subject. We also have to consider our posture when we work; for it makes a great deal of difference in the amount of energy we use, whether we work in an awkward position or an easy position. Working on the floor is not so efficient as upon a table of the right

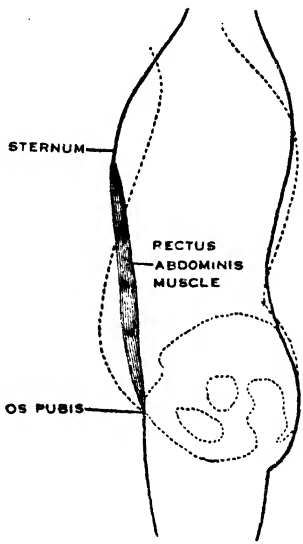


Fig. 47

Diagram of good posture showing well-developed rectus abdominis muscle in tonic contraction; dotted line showing poor posture with relaxed and flabby abdominal wall

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

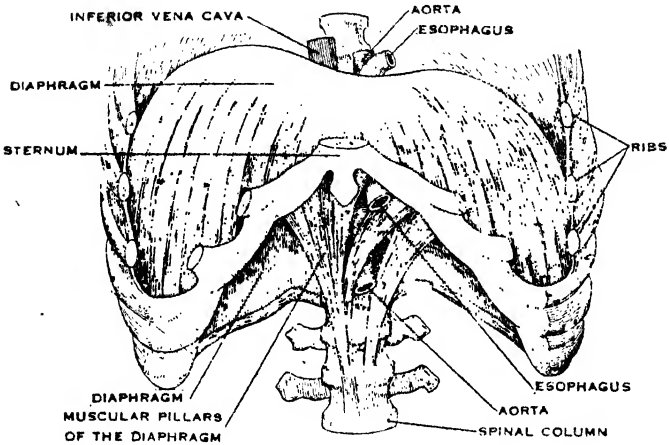


Fig. 48

The dome-shaped diaphragm

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

height. If the table or desk is either too high or too low, however, the worker becomes more fatigued. We cannot accomplish so much work, nor do it so well, if we are tired and our muscles ache. Therefore, it is of importance not only to our health, but to our prosperity, that we keep a good posture at all times.

Alcohol, *opium* and *tobacco* all affect the muscles and they may affect the heart. Their use reduces the muscular strength by at least one-third.

Exercise will develop the muscles, by making the fibres take in food and grow large and strong. If a limb is not used for a long time it will become small and soft, even though you take plenty of food. *Play* is the best form of exercise. Kho-Kho, Bus-Fugiti, etc., swimming, tennis, walking are all good forms of exercise. Everyone should take some time for games. General 'setting up' exercises may be taken by those who sit a great deal at their work.

Rest, too, is just as necessary as work for the development of the muscles. After work a muscle must have time to get rid of the waste matter in its fibres and to take in food and build up the cell fibres. If a muscle works too hard and does not have time for rest, it will become weak.

Bony structure of the body

What makes it possible for us to stand erect?

What prevents our vital organs from being injured?

How do the bones assist the muscles in making the body move?

We have learned how the muscles contract and relax in causing motion. These muscles are arranged between systems of levers which support the body and the muscles, by contracting, make one lever move upon another. These levers are made of hard tissues. The less hard are called *cartilages* or gristle. The harder ones are *bones*.

Experiment 27. If you take a small bone and soak it in strong vinegar, or weak sulphuric acid, you will see that the bone, too, is a mass of *tissue* (animal matter), which has had *salts of lime* (mineral matter) deposited in it, to make it hard.

Experiment 28. To show how much *mineral matter* there is in a bone, put one over a charcoal segri and burn out the *animal matter.* There is usually about twice as much mineral as animal matter in a bone; but this proportion depends upon the age of the bone.

When we are young our bones are softer, and as we grow older they become harder. This softness of the bones is an advantage to children and explains why old people break their bones when they fall more than children do, though they fall less often. There are about 250 bones in the body. Some of these bones, which are separate in the young, become united with age. An example of this is the thirty-three separate *vertebræ* in the spinal column (Fig. 49). The upper twenty-four remain distinct, but the twenty-fifth

to twenty-ninth unite into one bone called the *sacrum*; and the thirtieth to thirty-third unite to form the *coccyx*. In a similar way the bones of the head unite as we grow older, until there are only twenty-one separate bones in the skull when we are grown, though there are many more when we are young (Fig. 50).

The bones of children will not b r e a k so easily as those of old people and also they will mend more quickly if they are broken, because there is more living animal matter in them. It is the animal matter which keeps them from breaking and the mineral matter which makes them hard.

The burned bone will show that it is *porous* and if it is a leg bone it will also be *hollow*. The cavity of the bone contains a mass of connective tissue, rich in fat cells, which is called *marrow*, with *nerves* and *blood vessels*. The hollow bone is *stronger* in proportion to its weight than it would be if solid, and the porousness of the bone makes it *lighter* also.

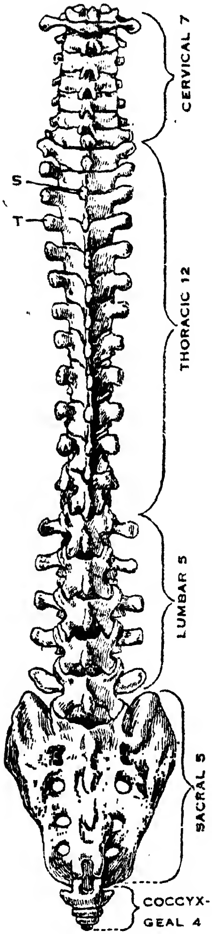


Fig. 49*

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Experiment 29. Set an open sheet of paper on end and try to support a

* Spinal column (seen from behind). S, spinous process; T, transverse process. Find the 7 cervical, 12 thoracic, 5 lumbar vertebræ. Do the sacrum and coccyx show evidence of having been divided in early growth?

book on it. •Fold the sheet of paper into the form of a small solid bone. See if it will now support the book. Next roll the paper into a hollow cylinder and place the book upon it. In which form will the paper best support the book? It contains no more material in this form. Does this explain why bones which have hollow cavities are so strong?

The ends of the bones are covered with a layer of *cartilage.* When this thins out, a layer of connective tissue begins and spreads all over the bone and is fastened tightly to it. This covering of bones is called the *periosteum.*

The work of the bones is to give *support* to the muscles so that they can pull. As we have said before, muscles attached to two bones can, by contracting, pull the two bones together. The bones thus act as levers. As you know, there are three kinds of levers, depending upon the position of the point of support, or *fulcrum*,[1] of the point which bears the weight, or resistance, and of the point which employs the *power* to overcome the resistance.

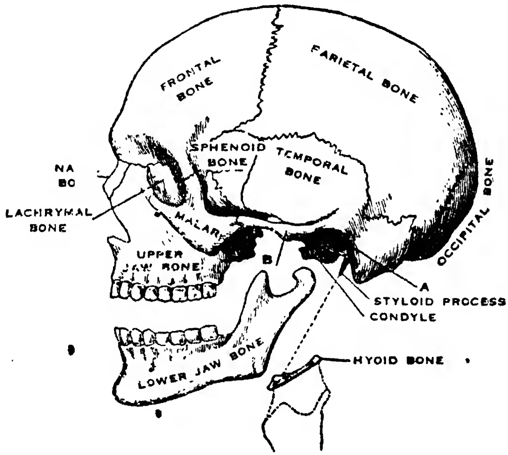


Fig. 50

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

When your raised foot is tapped on the ground, we use the *first order* of lever (Fig. 51). The fulcrum is between the power and weight. When you stand on your toes you

[1] See Part I, p. 110.

are using a lever of the *second order*, for the fulcrum is at one end and the weight is between it and the power (Fig. 52). If you lift a weight with your toes you use a lever of the *third order* (Fig. 53). The fulcrum is still at one end, the power is in the middle and the weight at the other end. There are many other examples of the way in which the bones act as levers. See if you can name some of them.

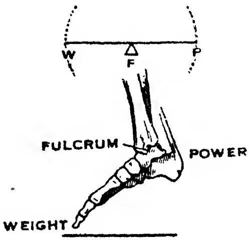


Fig. 51

Tapping floor with toe: lever of first order

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

In order that the levers may not slip, they are connected carefully by *joints*. In all perfect joints, the surfaces of the bone which must move upon each other are covered with cartilage and lining the joint is a membrane which secretes a fluid which acts as a lubricant. Firm fibrous cords, or *ligaments*, pass from one bone to the other and regulate the motion of the joint. The nature of the joint also regulates the motion and joints are named accordingly. Joints may be called *ball and socket*, when a rounded surface of one bone

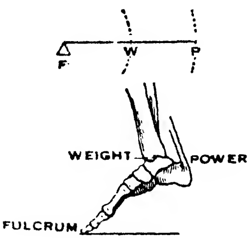


Fig. 52

Raising weight of body upon ankle: lever of second order

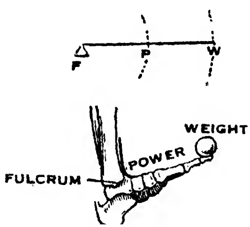


Fig. 53

Raising a weight upon toes: lever of third order

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

fits into a cup-like part of the other bone (Fig. 54). When the cup is deep, as in the hip joint, the motion is less than when the cup is shallow, as at the shoulder joint.

Hinge joints may be single or double (Figs. 55 and 56). The elbow is a good example of the single hinge joint and the wrist is a double hinge joint. A door, swinging one way or both ways, is an illustration of this joint. A *pivot joint* is one where the bone acts as a pivot on which another bone turns, or else turns itself on its own axis. The head rests upon the vertebræ of the neck and may be turned as on a pivot. Try placing your elbow firmly on the table and see if you can still rotate the hand. This is an example of the other type of pivot joint.

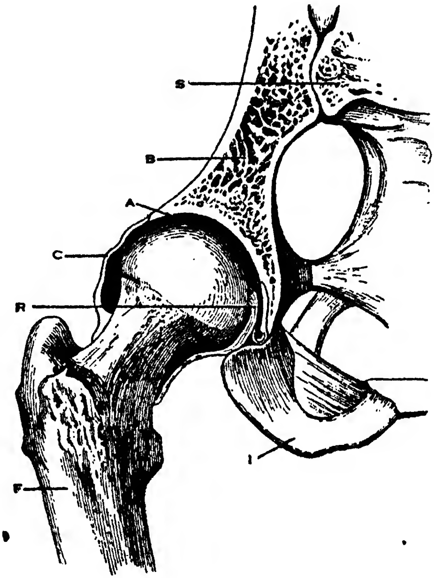


Fig. 54

The right hip joint: the hip bone sawed through so as to show the cup of the joint. A, head of femur in acetabulum; B, ilium bone of pelvis; C, capsular ligament; F, femur; I, ischium bone of pelvis; R, round ligament of hip joint; S, sacrum

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Bones, therefore, serve to increase the possibility of movement of the body. Some bones have *motion* as their chief function. Could you pick these out from the picture?

Bones also give *support* to the body. If we were without

bones we would be as soft as a slug or worm. Another of the functions of the bones is to *protect* our delicate organs. The supporting bones are mostly *round*, but the protective

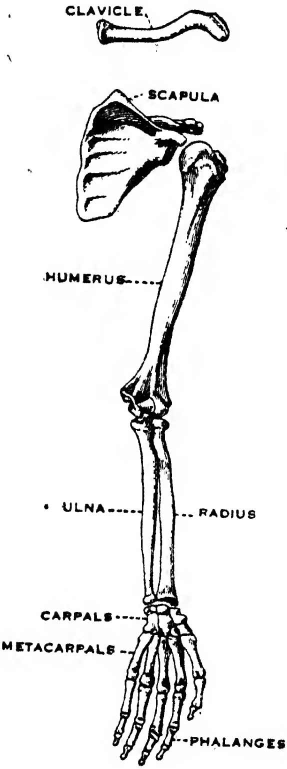


Fig. 55

The arm and the shoulder: seen from the rear. Why do the fingers seem so long?

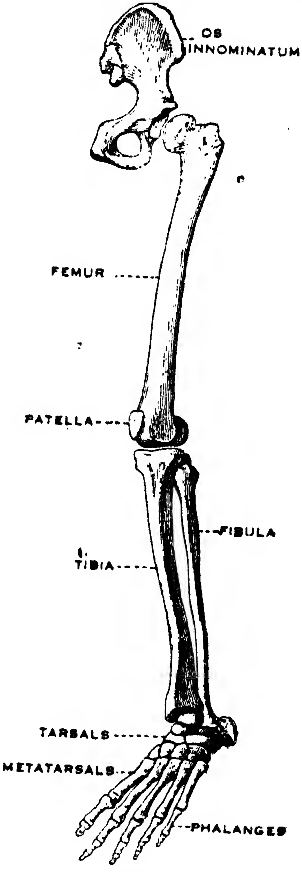


Fig. 56

Bones of the hip and leg: front view

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

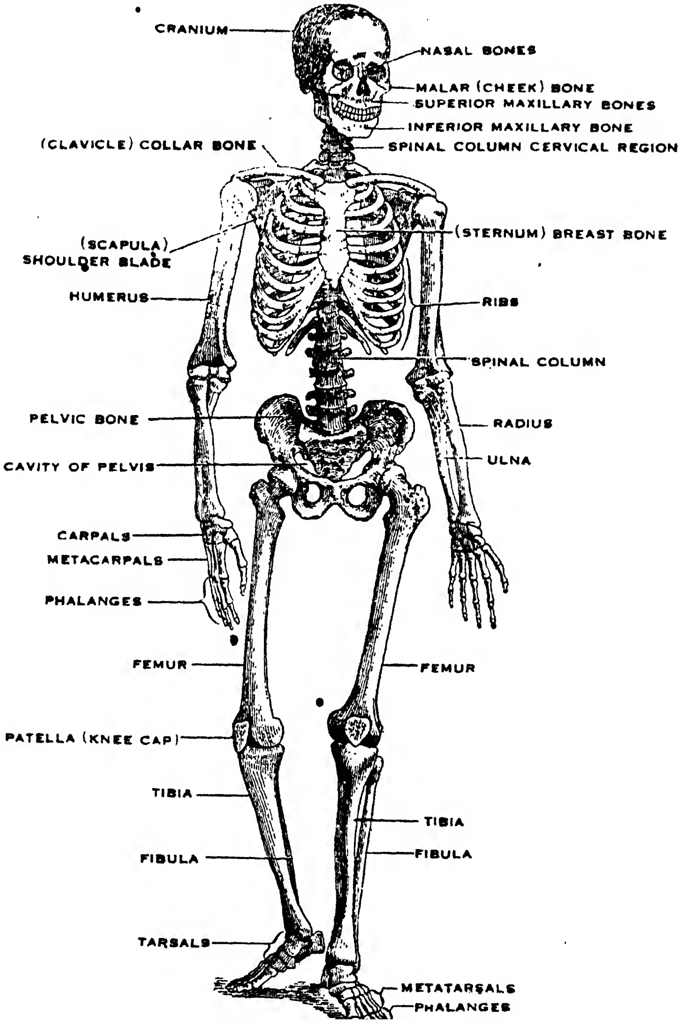


Fig. 57. The skeleton

The names of the bones are given, but it is not necessary to memorize them all.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

bones are *flat.* Look at the picture (Fig. 57) and decide which bones are chiefly for protection.

The bones usually have more than one kind of work to perform; but, nevertheless, their structure and shape has been determined largely by the *chief* work they have to do. The ribs, as an example, are constructed chiefly for protection, but they also assist in the motions of breathing. Besides the round and the flat bones, there are *irregular* bones, chiefly used for support, such as the vertebræ of the spine, the wrist, knee and ankle. They are also useful for protection and motion.

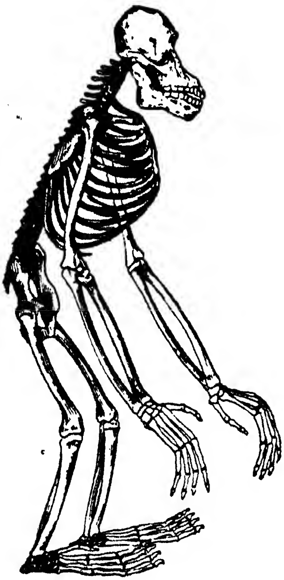


Fig. 58
Skeleton of an orang-utan
(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

If you compare the bones of other animals with those of man, you will find they resemble the human bones and yet there are differences (Figs. 57 and 58). See if you can note these differences and explain them by the kind of work which they have to do. Are the arm and hand bones of the monkey just like yours? How are the leg bones set on the pelvis of the monkey as compared with those of man? What differences do you note with respect to the head and spine?

By this time you will be able to name most of the bones of the skeleton from the picture. The *skull* contains originally twenty-eight bones (Fig. 50). What work do the eight bones perform which make up the box called the cranium? Fourteen of these bones form the face and there are six little ones in the ears. The *hyoid* bone, in the throat,

is useful for attaching the muscles, for moving the lower jaw. There are twenty-four *ribs*, twelve on each side. Notice that the two lower ribs on each side are not fastened at all in front. That is why they are called *floating ribs*. Seven pairs of ribs are fastened in front to the *sternum*, or breast bone, and are called *true-ribs*. Those that are fastened to the true ribs are called *false ribs*. See how slender they are as they curve around the chest. When you breathe they move the chest well upward and outward.

The ribs are attached in the rear to the backbone, or *spinal column*. This spinal column supports the head and upper parts of the body, as a stem supports a flower. These are the most important bones of all. We have talked of the number of vertebræ which make up the spinal column. See if you can remember; if not, look back and read again. The vertebræ are irregular in shape and accord well to the work they have to do, of holding the muscles. They have an opening through the middle through which the *spinal cord* passes, and the bones must *protect* this important part of the nervous system. At the same time they must *allow motion* of the spine, as well as *support* the head and keep the trunk erect. Between each of the vertebræ are elastic cushions which pad the spine and protect it from being jarred, as well as assist the movements of the spine.

The shoulders are formed by the two shoulder blades, or *scapulæ*, behind, and the two collar bones, or *clavicles*, in front. To these the arms are attached (Fig. 55).

The bone of the upper arm is named the *humerus*, and the two bones of the lower arm are known as the *radius* and the *ulna*. The wrist is called the *carpus* and consists of eight small bones, four in a row. The bones in the palm of the hand are *metacarpus* and consist of five long ones to which are attached the bones of the fingers, fourteen *phalanges*.

The leg is much like the arm (Fig 56). The hip bone

is called the *innominate.* It is large and flat, and joins on to the *sacrum* in the rear. These bones thus form a basin-like space called the *pelvis* which supports the bladder, the rectum and the generative organs. Into the sockets of the hip bones the big thigh bones of the leg, the *femurs*, fit. The two bones below the knee are named the *tibia* and *fibula.* The little bone over the knee is called *patella*, or knee-pan, and is to protect the joint. The ankle is called the *tarsus*, and is formed of seven bones. The *metatarsus* has five bones, which support the toes. The toes are also called *phalanges*, and there are the same number of bones as in the fingers.

The bones of the foot are arranged to form an arch from toe to heel. We must not wear shoes nor walk in a manner to destroy the arch. Our proper *posture* depends very largely upon this.

Teeth

1. Of what are our teeth made?
2. What is their use?
3. What causes them to decay?

The *teeth* grow from epithelial-forming cells. The *roots* of the teeth extend down into sockets in the jaws which fit so tightly they are held in place. The part which extends above the gum is called the *crown.* The main part of the tooth is made of *dentine.* This is the same substance as the tusks of elephants and is called ivory in commerce and is used for many purposes. In the centre of the tooth is the so-called *pulp-cavity*, and this soft pulp contains the nerves and blood-vessels which enter through the root. Below the gum, in the socket, the dentine is covered with *cement* and above the socket the tooth is covered with *enamel*, which is much harder than dentine. We should try not to injure the enamel, for it is the best protection against decay. The enamel will gradually wear through as we grow old; but if the teeth are kept clean the dentine

will serve every purpose, though it is more likely to decay than the enamel. Decay of the teeth not only causes their loss, but it is dangerous to health. The bad teeth, if not filled or removed, furnish breeding places for disease germs. The gums become sore, and the germs, growing about the roots of the teeth, form pus. The commonest disease of the gums resulting from this condition is called *pyorrhea.* Poison from the germs is carried by the blood to other parts of the body and causes various diseases, one of the most common being rheumatism.

Milk teeth are the first to be cut by a baby and they are sometimes called *temporary* teeth, because by the time we are twelve years old they have all been pushed out by the *permanent* teeth. The milk teeth are important for the development of the jaw; they should be as carefully looked after as the permanent teeth.

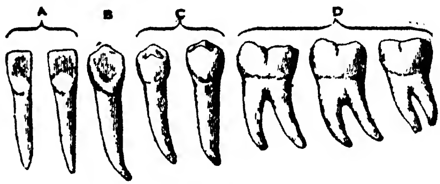


Fig. 59

Teeth from one side of the lower jaw of man; A incisors; B canine; C bicuspids; D molars

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

An adult has thirty-two teeth, named according to their uses. There are eight on each side of both jaws; and if you learn the names of the eight in one quarter of the mouth, you will know them all. From front to back, there are two *incisors*, or cutters, for cutting our food; one *canine* tooth, suited for tearing and used for this purpose by animals. The upper canine teeth are sometimes called eye-teeth. Next behind the canines are two *bicuspids* which are grinding teeth. Behind these are the three *molars* with rough surfaces for grinding also. The last molar is sometimes

called the *wisdom* tooth, because it is cut so late in life we are supposed by that time to have reached years of wisdom (Fig. 59).

The *causes of decay* in teeth are found to be these: (1) Eating only *soft food* which does not give the teeth enough work to do. Activity is the law of life, and unless a part is used it disintegrates. (2) By failure to keep the teeth *clean*, particles of food lodge in between the teeth and decompose, setting free an acid which attacks the teeth. (3) By allowing *tartar* to collect on the teeth. This, too, is caused by leaving the teeth unclean. (4) *Eating sweets* and allowing fermentation to take place in the mouth.

The custom of *cleaning the teeth always after eating* is a habit to establish if you wish to have pretty teeth and good health. Do not use any gritty substance on them or you will scratch the enamel, and then food and germs will collect in the groove and decay the teeth. There is no better brush for cleaning the teeth than the chewed end of an acacia stick. It is not necessary to have an expensive tooth brush; indeed one can clean them very well with the finger, using it with clean water to rub the gums and teeth. The teeth should be brushed with a circular motion, inside and outside. It is a good habit to eat some acid fruit at the end of the meal. The acid causes the saliva to flow freely, and the fruit helps to clean the teeth of any food which may adhere between them.

Teeth must be *repaired* if they decay, just as our shoes must be mended if they get a hole in them. It is easier to get new shoes than teeth; so keep your teeth clean and avoid trouble. Have your teeth examined at least once a year and repair any part which requires it.

First Aid

(1) *Broken bone* or *fracture.* If anyone should fall and fracture or break a bone, it is well to know what to do. You can readily understand that the broken ends must be put

together closely and *held close*, or they cannot knit together again. If the patient has to be moved, care must be taken not to displace the broken ends nor allow them to lacerate the flesh.

If the skin is broken, apply an antiseptic to prevent the entrance of pus-forming bacteria. There are many kinds of fractures and special methods of bandaging according to the position of the broken bone. (These may be studied in *First Aid to the Injured*, containing the syllabus for the first aid course of the St. John Ambulance Association.)

Take a puggaree or sari, and wrap around the limb. Then place pieces of wood (or even an umbrella) around it, and tie them to the limb to keep it straight and steady (Fig. 60). Should nothing be available, strap the broken leg to the uninjured leg, or a broken arm to the side of the body. Slip a blanket carefully under the patient, place two poles on either side and tie the blanket to, or roll the edges round, the poles; then the patient may be carried home and a surgeon called. Keep the limb straight until the doctor comes.

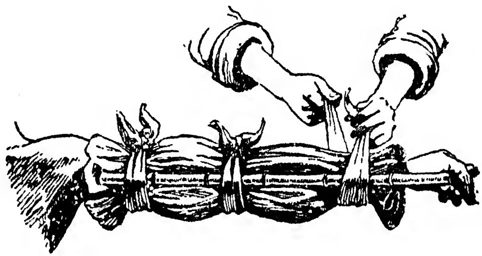


Fig. 60

Setting a broken bone before the physician arrives

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

(2) *Dislocation.* When a bone gets out of place it is usually because the *ligaments* have been broken around the joint. It takes a skilful person like a physician to pull it back into place, and you should call one to do this before the joint becomes too swollen. Then it must be kept in place. Remove

the clothing and place the limb on a pillow and apply cold water dressing. If that does not relieve the pain apply hot cloths. Keep the patient warm. The limb must be bandaged and gently exercised, but avoid dislocating the bone again.

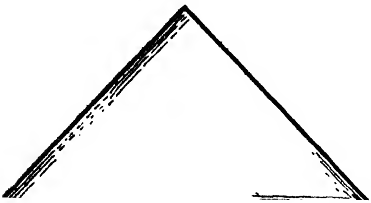


Fig. 61
A triangular bandage

(3) *Sprain.* The commonest form of sprain occurs when an ankle is turned too far, thus pulling the ligaments away from the bone. It heals by new ligaments forming to take place of broken or torn ones, but it often takes longer to heal than a broken bone. Treat in the same way as for dislocations. It is a good plan to stroke the injured part, pressing the blood up toward the body. Bandage carefully and exercise as soon as pain is gone and keep the joint from becoming stiff.

Fig. 62
Sling for arm made with triangular bandage

Everyone should know how to fold and apply a triangular bandage and to put on an arm sling (Fig. 61). A forty-inch-sided square of strong cotton cloth, cut diagonally across from corner to corner, will form two bandages; or a large handkerchief may be folded and used without cutting. In its triangular form (Fig. 62), it may be used as an arm sling required when any injury to the hand or arm necessitates it being raised

to prevent the flow of blood downwards. To put it on, place one end so as to hang a few inches over the front of the shoulder on the injured side. Take the bandage behind the neck, bring it over the other shoulder, spread it out on the chest with its point towards the elbow of the injured arm. Bend the arm on the middle of the bandage. Bring the hanging point outside the injured arm up the point hanging over the front shoulder, and tie the two points in a reef-knot. With two safety pins, secure the point at the elbow firmly to the bandage on the outside.

By folding the triangular bandage with its point to the base and then folding it in two, we have the broad bandage. If we fold it in three we have the medium bandage. By folding the broad bandage into two, we have the narrow bandage. The broad bandage may be used for a sling, instead of the unfolded triangle.

Posture. Where does the weight of the body fall when we are standing erect? Is it correct to walk with the weight on the outer side of the foot? Why do people who live in hot climates have better arches to their feet than people of cold climates?

Experiment 30. Place your wet foot upon a dry board or floor, to see where the weight of the body comes. The normal foot, when the weight of the body is properly balanced, will leave a dry place under the instep or arch of the foot (Fig. 63). Let your weight come more on the inside of the foot and the dry portion will be less (Fig. 64).

What did we say was the arrangement of the bones of the foot? The *arch* is lower on the outside of the foot, where the tissues covering the bones rest on the floor. The inner side is held high by ligaments and small muscles, attached to the bones of the foot and by tendons from the main muscles in the calf of the leg, which pass under this part of the foot and are attached to the toes. The heel bone

also lies more to the outside of the foot. Can you understand now why the print of your foot leaves a hollow and why it is natural to carry the weight of the body on the outside of the foot? We should, therefore, step with our toes *straight forward*. The arch of the instep may be broken down by the wrong way of walking. Sometimes the muscles of the foot as well as of the rest of the body sag because of weakness caused by lack of exercise or illness. Or the cause of the fallen arch may be due to wearing the wrong kind of shoes which distort the bony arrangement of the foot and throw a strain upon it (Fig. 65). The fact that in a hot climate we do not have to wear shoes is the reason for our having beautiful feet. It has not been customary for Indian women to wear shoes.

Feet that wear fashionable shoes, with pointed toes and high heels, are distorted and deformed. Indian women have beautiful posture and a queenly carriage, when they do not try to balance their bodies upon badly-shaped or high-heeled shoes. You cannot walk nor stand properly on such shoes (Fig. 66),

Fig. 63

The track made by a natural foot. Make a test by wetting your foot and noticing the track made upon the floor.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Fig. 64

The track made by a foot in which the natural arch has been partly broken down by tight shoes. If the arch breaks down entirely the foot is called flat foot.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

and bad posture leads to ill-health. The next best thing to bare feet is the Indian sandal, which protects the foot from the dirt and heat of the ground or pavement, but permits freedom of movement and perfect ventilation. Children should not wear any other kind of shoes in a warm climate, for in this way the foot can grow and develop normally.

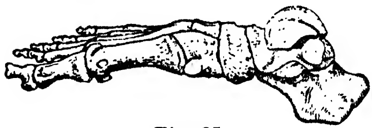


Fig. 65

Skeleton of foot. If the child never goes barefooted, the arch is likely to become flattened instead of high.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Where the climate necessitates shoes, select them with great care. The Punjabi shoes are too pointed, and they are not shaped into the instep, neither do they fit the heel snugly. The Deccani shoes have a free space for the toes and are straight, but the fact that they do not fit the heel causes one to walk in a scuffling fashion without lifting the foot and produces poor posture.

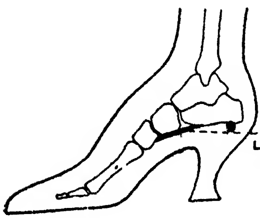


Fig. 66

After wearing high heels the small bones of the foot are adjusted to a certain position. If a sudden change is made in height of heel, pain and disability follow. Pain in the knees and hips follows wearing high heels.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

If you are inclined to use western shoes, make your selection with these principles in mind: (1) The shoe should be straight from toe to heel on the inner border, following the line of the normal foot (Fig. 67). (2) The heel should be broad and not more than an inch high. The back of the shoe should fit snugly about the heel. (3) The toe of the shoe should

be broad and allow perfect freedom for the toes. (4) The shank, or part of the shoe which fits under the instep, should be flexible.

Remembering how easily children's bones may be bent, we must be very careful not to confine their feet in heavy and wrongly-shaped shoes. Chinese children used to have their feet bent and bound, so that they would not grow large. This was not only painful, but it prevented them from walking and playing with freedom.

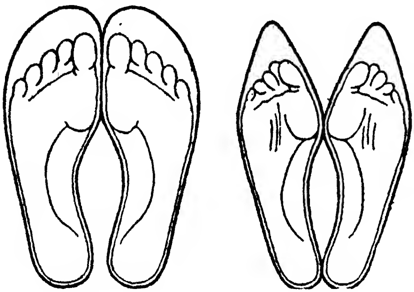


Fig. 67

Shoes should be made to fit the foot

Feet should not be crowded to fit the shoe

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Why do some people become stoop-shouldered before they are at all old? Will your knowledge of the bony structure explain this?

Experiment 31. Try the experiment of measuring your height very accurately against the wall at night, and again the next morning. Was there any difference? How can you explain this?

We have learned that the cartilage between each of the vertebræ of the spine can be compressed. The cartilage bears the weight of the bones, and as we become fatigued, our height is actually shortened by this compression. In the morning the cartilage has regained its normal size, and we are taller. If the body does not get sufficient rest under the right conditions and if, by improper ways of sitting, standing and lying, the cartilages are kept compressed, they become permanently misshapen, like the Chinese children's feet. Carrying our books or other weights on one arm may cause a *lateral* curvature of the spine. If we wish to carry burdens

in our arms, the weight should be divided equally between the two. What an excellent thing it would be if Indian girls would continue the custom of carrying light burdens, such as school books, on their heads, thus developing grace and dignity of carriage. People who sit in chairs to write, at tables that are too *high*, will have the same deformity. Sitting on the floor is conducive to flexibility of muscles and joints, but we must avoid bending where nature did not intend us to bend. Bend at the hips and do not let the shoulders sag or the head droop forward. If we do this, we will cause a *posterior* curvature of the spine. This is the reason so many women are round-shouldered and bent, looking as if they were very old long before they have any reason to do so. This same deformity may be caused by working at a table that is *too low*, by slipping forward in the chair and trying to rest on the small of the back, or by wearing shoes with high heels. These wrong postures cause flat chests and displacement of the vital organs. If the head is bent forward continuously, instead of being held upright, the upper cartilages of the spine are compressed in front and the ligaments are stretched so as to deform the person.

While we are young is the time to acquire right habits of posture. The bones are softer, we know, and while the skeleton is growing it can be bent into almost any shape. That is why a baby's thigh bones are sometimes bent outward by being carried so much upon the mother's hip. This deformity, known as bow legs, also comes from allowing heavy babies to walk too soon. This is also the reason why young people should not carry heavy burdens. When they are older and their bones have hardened, it will not injure them. Bending to grind spices and corn will deform women, unless they maintain their poise carefully and keep their backs straight.

Poor posture will let our muscles grow flabby and will cramp our lungs so that they can never be expanded to

the full. This means that our circulation will not be good and we will likely have trouble with constipation and suffer menstrual pain. The full development of the bones calls for the right food, but their correct position is the result of our posture habits. Painful and difficult labour at childbirth is the result of under-developed pelvis, weak muscles and displacement of the vital organs, often caused by wrong posture.

Correct posture affects not only our health, but our attitude of mind and outlook upon life. If the whole body from toe to head is held in correct position, feet parallel, waistline drawn in, diaphragm drawn up and the whole body stretched tall, with head erect, our muscles and internal organs can do their work without friction. It gives us a feeling of elasticity, balance and poise, that engenders courage, confidence and hope.

AGENDA

Oral and Practical Work

1. What animals have their skeletons on the outside of their bodies? What use is this to them? How do they meet the necessity of growing?
2. How does an earthworm move its body, since it has no skeleton?
3. Why is it important in early life to keep the skeleton of your body in proper shape? In what ways may it be deformed?
4. What are the chief functions of the muscles?
5. How do the muscles move the body?
6. How can we keep our bodies in an erect posture? Practise carrying light burdens on the head.
7. What is the importance of exercise?

Try These Exercises Daily:

Stand

1. Feet *close* and neck *rest*. Feet *open* and hips *firm*.
2. Slow breathe *in* (nose). Slow breath *out* (mouth).
3. Arms upward *bend* and feet astride *place*. Trunk forward *bend*: *raise*. Chest *lift* and head backward *press*: *raise*.

4. Arms sideways *stretch* and to the left *face*. Upwards *stretch* and to the right *face*.

5. Hips *firm*, with left foot forward *lunge*. Foot *change* with right foot forward *lunge*.

6. Arms across chest *bend* and heels *raise*. Knees outward *bend*. Arms sideways *fling: bend*.

7. Down *kneel*. Hips *firm*. From the knees backward *bend: raise*.

8. Right hand neck *rest*, left hand hip *firm*. Trunk to the left *bend: raise: bend: raise*. Arms *change*. Trunk to the right *bend: raise: bend: raise*.

9. Heels *raise*. Feet astride *jump*. Feet together *jump*.

10. Arms lifting forward, upward, slowly deep breathe *in*. Arms sinking sideways downward slowly deep breathe *out*.

Note.—Repeat each exercise four times and stand at ease and rest after each.

This table is built up and adapted from exercises given in tables in *A Handbook of Free-Standing Gymnastics*.

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CHAPTER V

THE CIRCULATION

'A friend in need is a friend indeed.'

Required.—Watch with second hand, cloth for bandages and pads.

WHAT is meant by the circulation of the blood?

What is the function or work of the blood?

If you cannot answer these questions you will want to study about the blood and its circulation to find out. We must start our discussion with the well-known fact that the body is made up of hundreds of billions of tiny cells, fitted cunningly together to form the tissues, bones, muscles, nerves, blood and all. You know also that each tiny cell must have food, water, air, and be able to get rid of its wastes just as any individual must do, if it is to live and grow and keep well. How are these cells to be provided with the things they need? How are they to get rid of their wastes? The carrying is done by the *blood.* The work of the blood then is *to carry food, water and oxygen to the cells and to carry the wastes away from the cells.* How does it accomplish this work?

If you look at the diagram (Fig. 68) and illustration (Fig. 69), you will notice a great system of tubes, called *blood-vessels,* passing all through the body. Note, too, that they are connected with the heart. From the time we are born until we die, the blood flows through these blood-vessels to the heart and away from the heart again all over the body. This passage of the blood through the heart and blood-vessels is what we mean by *circulation.* If the blood did not circulate through the body we would soon die. It is only by this means that the cells can be supplied with

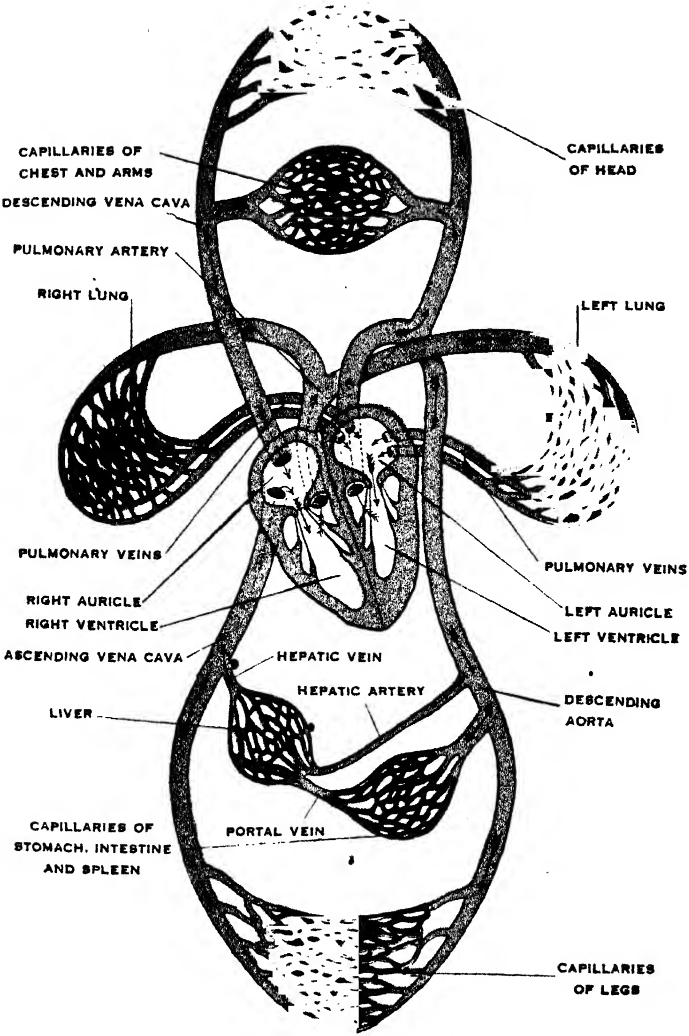

Fig. 68

Diagram of the circulation of the blood in the body

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

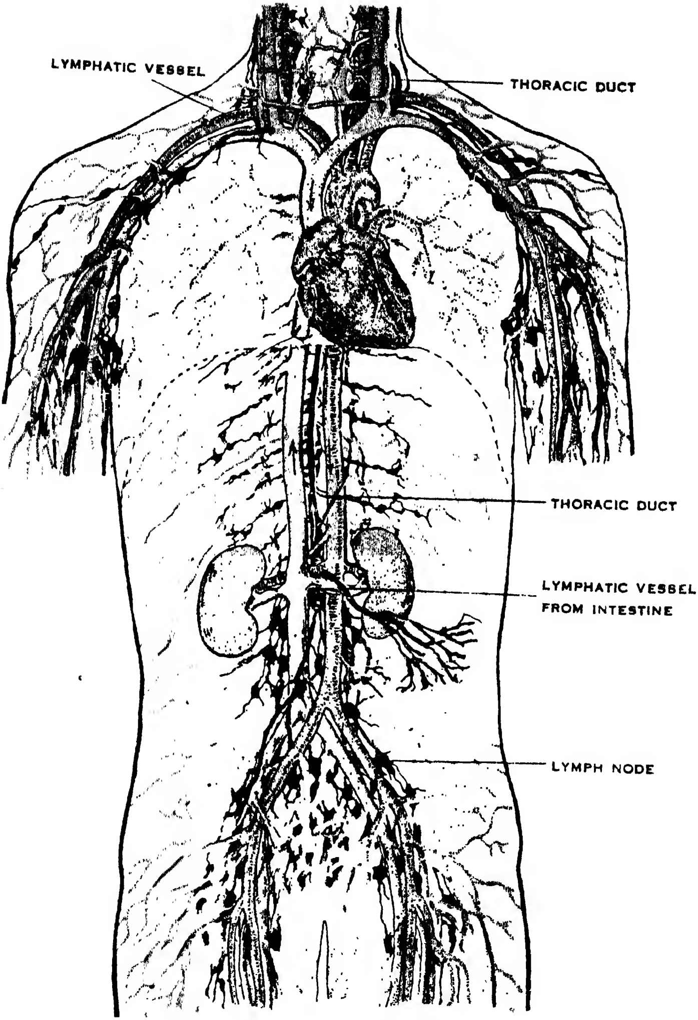

Fig. 69

The heart and the principal vessels of the body

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

food, oxygen and water, and have their wastes carried away. The cells would be starved otherwise, and the body would be poisoned by the wastes. You can see how important it is that we keep up a good circulation. The heart and the blood-vessels are called the *circulatory organs*.

The *heart* is like a pump, and its work is to force the blood through the blood-vessels.

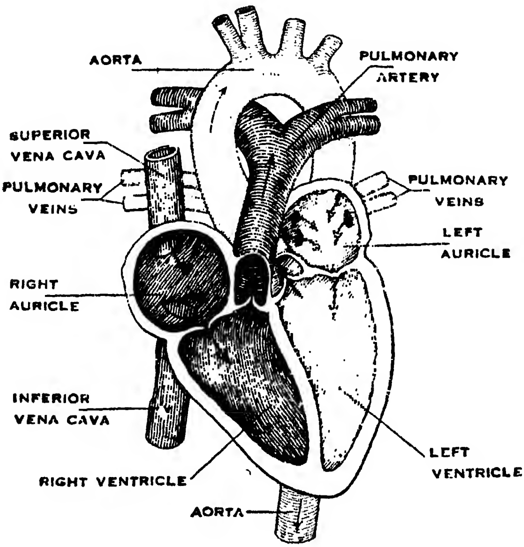

Fig. 70

Diagram to show the course of the blood through the heart. The vessels containing impure blood are drawn darker than the others.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Your heart is about the size of your fist. It lies to the left of the centre of your body, in the chest cavity. It is divided into four parts; the two hollow parts above being called *auricles*, and the two lower ones *ventricles* (Fig. 70). The heart is made up of strong muscle fibres which have

the power of contracting. So when the blood flows into the auricles, the heart contracts and squeezes it down into the ventricles. Then the walls of the ventricles contract and squeeze the blood from the ventricles into the *arteries*, as the blood-vessels, leading away from the heart, are called. The blood then passes over the body and through the lungs, and back again to the heart. The blood-vessels which bring the blood to the heart are called *veins*. If you put the fingers of your right hand on the wrist of your left hand, you can feel the *pulse*, or throbbing of the blood, as it is driven by the heart over the body. How many beats can you count in one minute? This shows you how fast your heart muscles are contracting to force the blood out of the ventricles into the arteries. The heart beats 130 to 140 times a minute at birth, and gradually becomes slower as adult life is reached, when its beat is but 70 to 80 times per minute.

Between the auricles and ventricles, and between the ventricles and arteries, are little doors called *valves* which can open only in one direction. It is as if the door were tied by a string which prevented it from opening except in one direction. This is really the case with the valves, but the strings are called *ligaments*. When the auricles contract, the blood is pushed through the little door down into the ventricle; but when the ventricle contracts it cannot go back the way it came, as the door is held shut by the ligaments. It must, therefore, leave by the other door leading into the arteries. After it has passed into the arteries it cannot return to the ventricles, for the little doors are again closed and tied shut. In the arteries there are more valves to prevent the blood from returning to the heart. The blood must always be moved *forward* in the same way, from veins into the right auricle, from the right auricle into the right ventricle and from the right ventricle the blood enters the *pulmonary artery* and its branches. From the

branches of the pulmonary artery the blood flows into the capillaries of the lungs. From the capillaries of the lungs it passes into the four pulmonary veins. From the pulmonary veins it flows into the left auricle. From the left auricle it flows into the left ventricle. From the left ventricle it flows into the *aorta* artery and its branches. The arteries divide and divide into smaller and smaller blood-vessels until they are like a network. These tiny vessels are called capillaries. The capillaries run everywhere among the cells of the body, and then begin to unite again into larger and larger blood-vessels called veins. At last all the veins unite into two large veins, called the ascending and descending *venæ cavæ*, which empties the blood back into the right auricle of the heart again.

How long do you suppose it takes the blood to run all this long way? It runs very fast, for it does not take even a minute to go all over the body and back again to the heart. Wouldn't you think it would require rest sometimes?

All our lives the heart must keep up its beating and, as you counted just now, it beats from seventy to eighty times in a minute. Its only rest is between each beat. The faster the heart beats, the less rest it gets. Very hard work, or exercise too long continued, may injure your heart. Young people and old people must be especially careful. This does not mean that moderate exercise and short periods of severe exercise are injurious, for they are not. On the other hand, they are good to strengthen the heart. But if the heart does not get sufficient rest the cells of the muscle will degenerate.

The usual symptoms of heart-disease are shortness of breath and swelling of the legs, not pain. Poor circulation through the lungs causes the shortness of breath, and the legs swell because it is harder for the heart to pump the blood up from the feet than it is to get it down from the arms and head. If the patient's heart is not relieved he

may find he cannot breathe when lying down, and a cough is likely to be manifested. There are four chief kinds of heart-disease. One type usually begins in childhood, and more often with girls than boys. It is caused by the special *streptococcus* which causes colds, tonsilitis and rheumatism. If one is careful in the way of living and gets no further infection of the germs, the body may get well.

The treatment for all kinds of heart-disease is *rest*. The doctor will probably prescribe digitalis; but *rest* is the most important factor of all.

While the body is growing the heart must grow too and, if the body grows large quickly, the heart sometimes has difficulty in doing its work. Some things, therefore, which grown persons may do are not good for growing boys and girls to do. Regular, moderate exercise is essential to make your hearts strong, and regular sleep is also necessary to give them time for rest. Young people must avoid tobacco, for this will weaken their hearts and prevent them from working hard, though they may not feel sick.

Of what is the *blood* composed? How does it carry the food, water and oxygen? How are the wastes disposed of?

The blood has a yellow liquid, called *plasma*, which you can sometimes see when you wound your skin. It is mostly water, but dissolved in the water are food and many other substances. In this yellowish stream are little bodies, called *corpuscles* (which we may liken to little submarine boats floating in a river). There are two varieties of corpuscles, differing in size, colour and in the work they perform. You must realize that they are very small indeed when you are told that in a drop of blood, no larger than the head of a common pin, can be found about five million *red corpuscles*. The red corpuscles are really yellow, but when there is light reflected from a large number of them they look red and are so named. They are formed in

the bone cavities, and when they die the liver uses them for making bile. They are flat and circular in shape (Fig. 71). These little corpuscles have a very important work to do, which you will understand better when we come to study about how we breathe. *The red corpuscles take the oxygen from the air we breathe into our lungs and carry it to all the cells of the body.* Oxygen is in the air we breathe, and with each inspiration we fill our lungs with air. The blood is brought to the lungs, as we have just learned, by the branches of the pulmonary artery and its capillaries. The red corpuscles are in this blood, and they take the oxygen from the air and carry it back to the heart. The heart then sends it to all parts of the body, and from them the cells take the oxygen. Their power to carry oxygen is due to the iron in the red corpuscles. I want you to remember this when we come to talk about food materials in a later chapter.

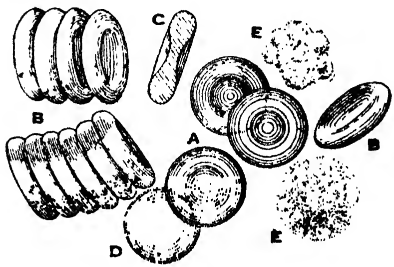

Fig. 71

Blood cells. A, red corpuscles seen from the side; B, red corpuscles, seen on edge, are run together in rows; C, section through middle of red corpuscle; D, red corpuscle swollen with water; E, white corpuscles.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

When the cells receive the oxygen, they use it to burn the food and old parts of the cells, to produce heat and energy. If the corpuscles did not bring oxygen to the cells they could not live, and the whole body would die. After the red corpuscles have delivered their load of oxygen to the cells they sail to the lungs for another load. When the red corpuscles have a fresh load of oxygen the blood looks bright red, but after they have delivered the oxygen to the

cells the blood looks dark. You can understand now why the blood in the arteries, coming from the heart, is brighter coloured than the blood in the veins, returning to the heart.

The other little *boats* in the blood are white and therefore are called *white corpuscles* (Figs. 71 and 72). They do not keep a rigid shape as the red ones do; but, being soft and jelly-like, can change their form as they float about in the blood plasma. These may be likened to little battleships, and their work is to *kill germs* which may enter the body (Fig. 16). They collect in a regular fleet and surround the germ, destroying it by digesting it. If they win the battle, then disease is checked; but if the germs destroy the white corpuscles with their poisons, the disease will continue.

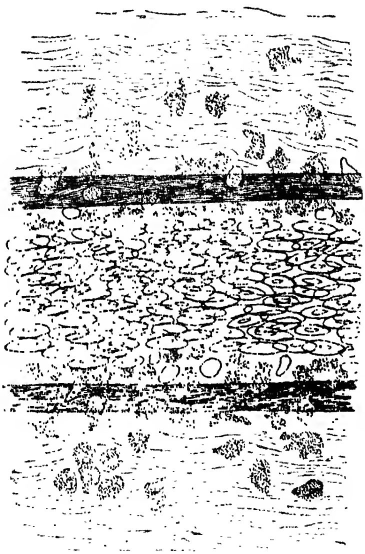

Fig. 72

Migration of white corpuscles through the walls of a vein. They are shown in different stages of migration. The red corpuscles remain in the stream.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

Fever. This warfare, together with the toxins or poisons produced by the disease germs and excessive oxidation, helps to bring about a heightened temperature which we call fever. The poisons have the effect of more or less paralysing the nervous system, and so the patient loses, temporarily, the power of regulating vital processes. The heart beats more rapidly. The power

of absorbing food is lessened and the body tissues are consumed. This throws a heavy burden on the excretory organs and increased body wastes accumulate in the blood, giving rise to headache and local inflammation. It is important to keep the pores of the skin open and the sweat glands active (Fig. 73), to permit escape of the heat and poisons. That is why, in cases of fever, we induce perspiration.

The pulse indicates the rapidity of the heart beat. The pulse rate varies according to age and other conditions. The normal pulse in a man is from 60 to 70 beats per minute; in a woman, from 65 to 80 beats; and in a child, from 90 to 100 beats. Excitement and fever increase the heart beat.

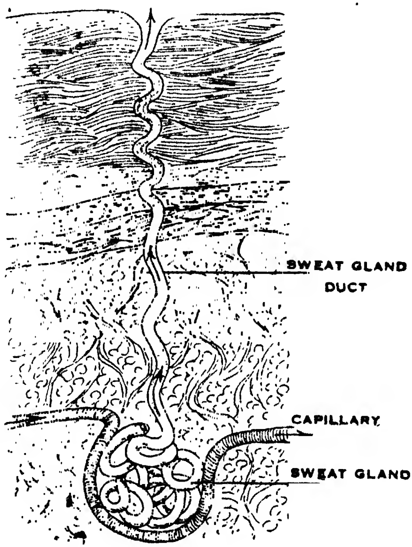

Fig. 73

Sweat gland of skin removing waste from the blood

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

We can better understand the absorption and distribution of our digested food, since we have learned about the circulation. When the starches which have been changed to simple sugars, and the proteins which have been split up into simple *amino acids*, pass out through the walls of the intestines into the blood capillaries, they are carried by the portal vein to the liver (Fig. 74).

The *liver*, we will learn, secretes *bile*; but it does two other kinds of work as well. It has the power to take and *store the extra sugar* which we have digested until it is needed. Only a small amount of sugar is allowed to enter the circulation at a time. The proteins, in the form of *amino acids, pass through the liver* and are carried by the blood all over the body. The amino acids and some of the sugar, being dissolved in the blood plasma, can pass through the thin walls of the capillaries and fill all the spaces surrounding the cells and tissues. This escaped plasma is called *lymph*, and all the cells are surrounded by lymph (Fig. 75). The cells can take the amino acids they need and build them up again into the particular protein they require. What is not needed for this purpose is burned by the cells, *as the sugar and fat are*

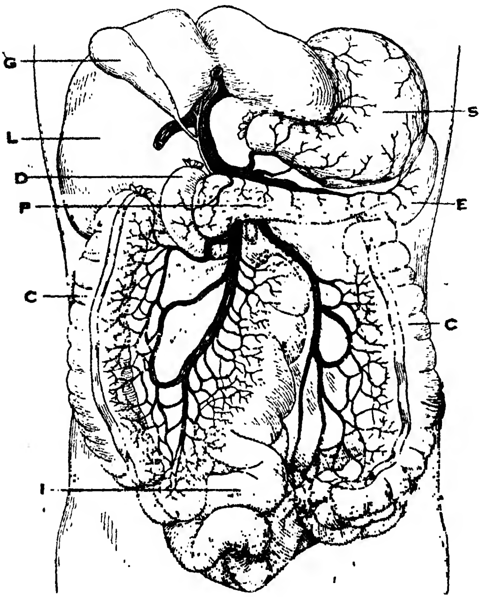

Fig. 74

Abdominal viscera displayed so as to show the portal vein carrying the blood from the viscera to the liver. L, liver; G, gall bladder; S, stomach, and D, duodenum—these have been divided from each other; P, pancreas; E, spleen; C, large intestine; I, small intestine. The transverse colon and part of the small intestine have been removed.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

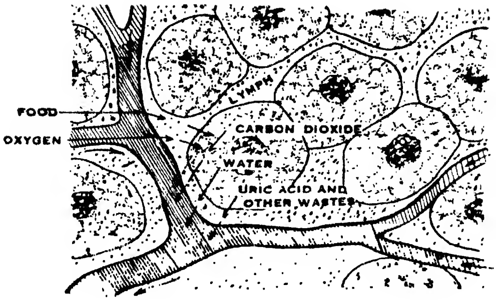

Fig. 75

As the blood flows through the capillaries it gives food and oxygen to the cells and take wastes from the cells. The lymph acts as a middleman between the cells and the blood.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

burned, by combining with the oxygen. The oxygen passes through the walls of the capillaries, leaving the red corpuscles behind, enters the lymph, and so reaches the cells. The fat arrives by a different route, of which we will soon learn. When the foods are burned they produce carbon dioxide, uric acid, urea, and other wastes. These wastes pass through the walls of the cells into the lymph, and so through the capillary walls into the blood (Figs. 76 and 77).

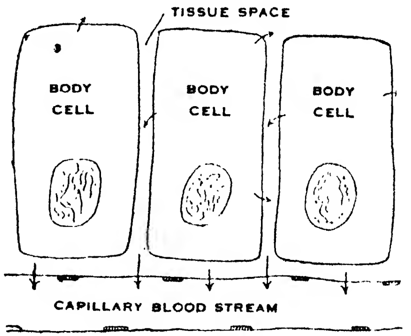

Fig. 76

Waste from the cells going into blood stream

(From *Healthful Living*, by Dr. J. F. Williams, The Macmillan Co., New York, 1921.)

We have already seen in Chapter II that a large quantity of

water and a small quantity of poisons, wastes and some carbon dioxide are eliminated by means of the skin. The remainder—the greater part—of the carbon dioxide and some water are got rid of by means of the lungs, as you will learn in Chapter VI. The organs that purify the blood of the rest of its wastes, that is, the greater part of the urea, uric acid and other poisons, and of its excess of water, are the kidneys — two small, dark, bean-shaped organs that lie embedded in fat rather high up, one on each side of the back of the abdominal cavity. Branches from the aorta and the vena cava (Fig. 68) enter and leave these organs, sending branches which diminish into capillaries, into every part of them. As the blood passes through these branches certain *tubules* (little tubes, Fig. 78) in the interior of the kidney have the power to absorb from the capillaries the wastes and water, then together called *urine*. This urine is carried by pipes, called *ureters*, into the *bladder* (Fig. 79), whence it is passed through another pipe, the *urethra*, out of the body.

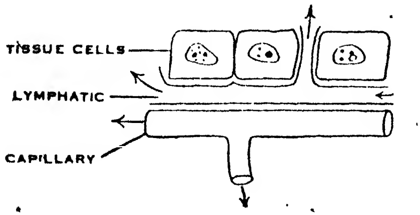

Fig. 77

Diagram to show functions of lymph and origin of lymphatics

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

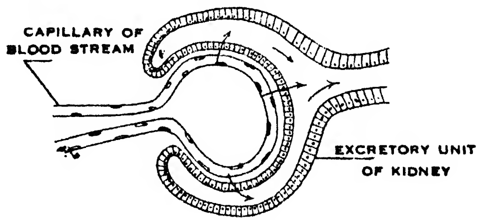

Fig. 78

The elimination of waste by the kidney

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

The secretion of urine by the kidneys is always going on. If they fail to do their work properly we become ill. If they cease to act, we die. Chills, the consumption of too much protein and the use of alcohol are the chief causes of disease in the kidneys.

The *spleen* (E in Fig. 74) is the largest *ductless gland* in the body, situated above the left hip. Its functions are not clearly understood, though it appears to help *form* red blood corpuscles in the pre-natal development of the body. It has been proved that the spleen *destroys* red corpuscles when they are worn out. It seems that the spleen plays some part in the storing of proteins which have been absorbed during digestion. The blood from the spleen is carried to the liver, where the hæmoglobin is split up into the bile pigments and iron.

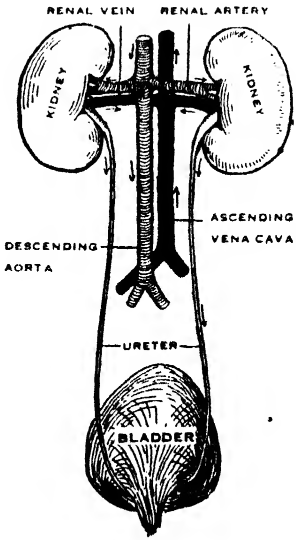

Fig. 79

The kidneys and the bladder as seen from behind

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Whatever the work of the spleen may be, it cannot be very important, for if it is *removed* the body seems to get on quite as well without it as before.

The lymphatic system. The circulatory system, of which we have been talking, is similar to the water-supply system in a city, with its pump and pipes for distributing water to all the people. The lymphatic system more nearly resembles the drainage system of a city, for its work is to drain off the stale, impure lymph from among the cells and empty it into the blood. When

the stale lymph is removed, this gives place for fresh lymph to flow among the cells, with a new supply of food and oxygen. The lymphatic vessels consist of fine thin capillaries which lie among the body cells as the blood capillaries do. The lymph capillaries unite to form larger vessels, which finally unite in one large vessel, called the *thoracic duct.* This duct empties into the large vein in the left shoulder.

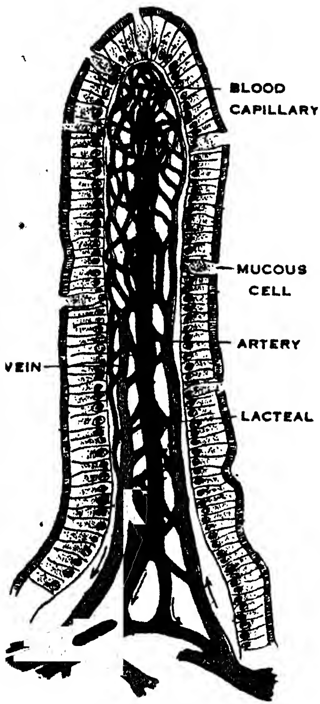

Fig. 80

A villus and its vessels. The lymphatic vessels (lactals) are in black.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

Now we shall learn how the *fat* which we ate in our dinner finally reached the cells (Fig. 80). The little lymphatic capillaries which lie in the walls and villi of the intestines not only do the same work that the other lymphatic vessels do, but they also take the fats from the intestines and carry them to the lymphatic vessels, and finally they are emptied into the thoracic duct. From this they flow into the blood, and thus pass all over the body and so reach the cells.

Fat may either be burned for heat and energy by the cells, or it may be stored as fat for future use when you are ill and cannot eat. The body will use the fat and protein of its tissues to supply the cells in such a case. That is why a sick person, who has been on a long fast, feels so weak when he gets about again.

There are also little filters, called *lymph nodes*, that filter out the disease germs. They are like little sacs, made of connective tissue, and they are breeding places for the white blood corpuscles. Do you remember what was the work of the white corpuscles? The lymph flows through these nodes, and if there are any germs in the lymph the white *corpuscles set upon them and destroy them.*

First aid. You can understand now why the blood flows when you cut yourself. How could you tell whether it was a vein or an artery? What is the difference in colour of the blood in an artery as compared with a vein? Does the blood flow in the same manner and in the same direction from an artery as from a vein? If it is necessary to stop the bleeding from such a wound, it would be wise for you to remember these differences.

The blood comes away from the heart through the arteries and therefore, being fresh and with new oxygen in the red corpuscles, the colour is bright red. The blood in the veins you know has lost its oxygen and it looks dark. The heart pumps the blood into the arteries in jumps; with each beat of the heart the blood jumps into the arteries. But in the veins it has a steady flow. How can you stop a cut from bleeding? If you should cut an artery, it would be necessary to stop the flow from the direction of the heart. If a vein is cut, you would staunch the flow from the direction farthest from the heart. How could this be done? First stop the bleeding by pressing hard with your finger above the cut; if it is an artery, then tie a cloth or piece of rope tight around the limb, between the cut and the heart, if possible where an artery passes over a bone. See illustration (Fig. 81). Place a knot of the cloth so that it will lie on top of the artery. If this is not sufficient, put a stone or pad, or piece of money, under the knot. To make the binding very tight, put a stick through the cloth and twist it; such a bandage twisted tight is called a

tourniquet (Fig. 82). Do not let the binding stay more than twenty minutes without loosening it for a moment. Raise the part of the body that is bleeding. Why? When you loosen it again, press the finger over the artery, to keep it from bleeding. Tie it up again, unless the doctor has come. The treatment of a *bleeding vein* is similar, only remember that the pressure should be on the part *farthest* from the heart, that is, between the extremities and the wound.

If your nose should bleed, do not lie down, but keep the head up. Sit in front of the window with your arms up, and get some one to hold them so. Breathe through the mouth instead of the nose. If there is someone to help you, have them place a cold, wet cloth over the nose and also at the back of the neck (ice is better). Place the feet in hot water. Sometimes it will stop the bleeding if you put a wad of paper between your upper lip and teeth, and then press on the outside. In small cuts, the bleeding is stopped by the clotting of the blood. Do not wash away the clot nor blow your nose, or the bleeding will begin again. A simple method of stopping the nose from bleeding is to compress the nose between the finger and thumb for 10 minutes.

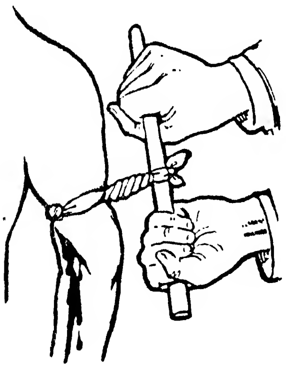

Fig. 82
Checking bleeding from a wound
(From *Primer of Hygiene*, by Ritchie and Caldwell. World Book Co., New York, 1920.)

Internal bleeding, called internal *hæmorrhage*, needs immediate attention from a doctor. Till he comes, keep the patient lying flat, undo his collar, give fresh air and fan him. Give ice to suck or cold water to drink, apply ice-bag

locally if the seat of the injury is known. If faint, treat as for fainting, but give no stimulant to drink.

The blood, through the blood-vessels in the skin, responds very readily to changes of temperature. As we have seen, in treating snake bite and hæmorrhage, heat or cold tend to coagulate the blood and to check its flow. The application of warmth on the skin brings the blood to the surface; the application of cold drives it to the internal organs. In *headaches and sprains*, where the pressure of too much blood causes heat and pain, we apply ice; where pain is felt internally, we apply hot fomentations to draw the blood to the surface. When the skin is exposed to sudden chills the blood rushes inward, and sometimes sets up inflammation which brings about a condition favourable to the development of a cold. A hot mustard bath for the feet will draw the blood downwards from the over-heated internal regions, and thus help in checking the cold.

AGENDA

Oral and Practical Work

1. Why is the circulation of the blood necessary?
2. What work does the heart perform?
3. How fast does the heart beat?
4. What use are the valves?
5. Explain what arteries, veins and capillaries are, and how the blood flows through them.
6. How do their walls differ, and how does the artery change the size of its opening?
7. Trace the circulation of the blood.
8. What two kinds of corpuscles are in the blood?
9. What are the functions of the lymph nodes?
10. What work do the white corpuscles perform?
11. Where are the red corpuscles formed?
12. What function belongs to them?
13. Where are they destroyed?
14. What substance in the blood carries oxygen? How is the carbon dioxide carried?
15. What is the work of the lymphatic vessels?

16. How do the absorbed sugar and proteins reach the blood?
17. How do the absorbed fats reach the blood?
18. Why does over-exertion injure the heart when we are young?
19. What are the other causes of heart trouble?
20. Why should we avoid 'headache-medicines' and alcohol? What is the effect of tobacco on the heart?

Exercise 1. Count your pulse beats for 30 seconds, and estimate how many heart-beats are to the minute. To do this place the finger ends (never the thumb) along the course of an artery near the surface of the body, and count the number of beats for one minute. It is generally taken at the wrist, near the thumb side. Take it twice, to be sure you make no mistake.

The blood in the arteries flows in spurts, and in the capillaries and veins in a steady stream: explain the reason.

How would you stop nose-bleeding?

How would you know a case of arterial hæmorrhage?

Would you always elevate a bleeding limb?

How should pressure be first applied?

What is a tourniquet?

Why is it necessary to be accurate in placing a pad for a tourniquet?

Exercise 2. Improvise and apply a tourniquet at different points. Pupils should practise placing patients in proper positions to arrest hæmorrhage, folding firm pads, tying hard knots, and applying bandages.

Exercise 3. Press on a vein in your wrist with one finger, and rub another finger along the vein on the side toward the heart. Does the blood flow back into the vein? On the other side of the finger that is pressing the vein, rub the blood away. Does it flow back again? Explain the reason.

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CHAPTER VI

THE RESPIRATION

'Day and night, air and light, everyone must have.'

Required.—Watch with second hand, and a mirror.

WHAT is the work of the lungs?

How should we breathe?

Watch one of the other students, or a member of the family, as they sit resting, and see if you can count how often the chest rises and falls in one minute. With each rise and fall of the chest, air is being breathed in and out of our lungs. This is called the process of *respiration*. Make note of the number of respirations per minute. Do you know why we respire or breathe? Let us state it clearly. *We breathe in order to take oxygen into our bodies and*

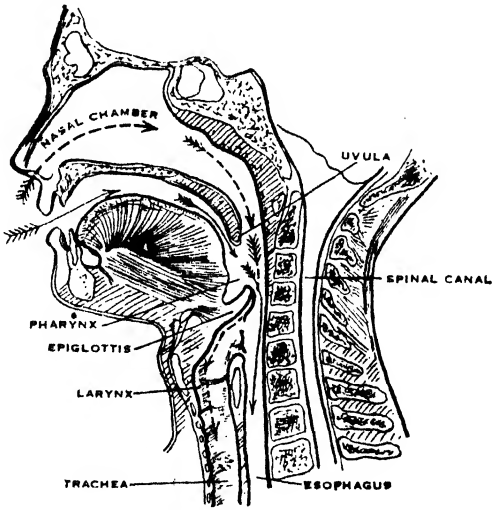

Fig. 83

The air follows the path indicated by the dotted arrows, and the food follows the path indicated by the continuous line arrows.

(From *Human Physiology*, by Dr. J. W. Ritchie, World Book Co., New York, 1913.)

get rid of the carbon dioxide. Let us now consider how this is done. There must be some arrangement for *exposing a large amount of thin tissue to the air* which contains oxygen (or, if it is a water-animal, the tissue must be exposed to the water which contains the oxygen). We must have some kind of *mechanism for keeping the air on one side of this thin tissue* and the blood on the other, and for changing them constantly.

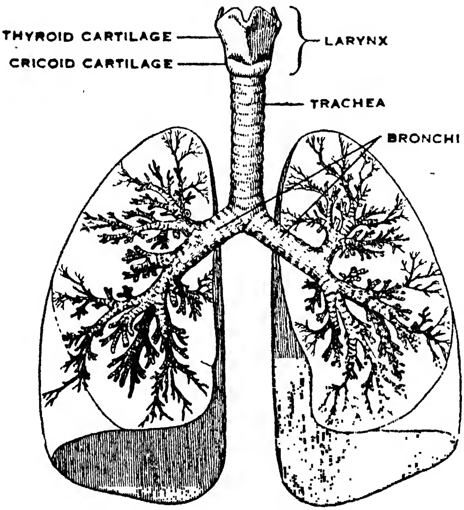

Fig. 84

Not all of the divisions of the bronchi are shown, but notice how these tubes by the finest branches extend to all parts of the lungs.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

When we breathe the air generally enters the *nose*, and this is the correct way for us to breathe. Later we will learn of the ill-effects of mouth-breathing.

Two holes lead from the back of the nose into the back of the mouth and to the funnel-shaped cavity of the throat (Fig. 83). Both the nose and the mouth open into this cavity which is named the *pharynx*. Situated in the pharynx are four glands called tonsils. One is to be seen on each side, one at the back of the tongue, and one higher up on the back of the throat. You will learn more of these later. Below the pharynx are two tube-like openings. We

shall speak later about one of these tubes, when we follow the passage of the food to the stomach. It is called the *œsophagus*. The other is the wind-pipe, or the *trachea*. At the top of the trachea is the voice-box, or *larynx*. There is a little lid (the epiglottis) to shut the trachea, when we swallow food and water, to prevent them from entering the trachea; but sometimes, when we cough, we let food get into the trachea, and it causes us to choke. The wind-pipe, or trachea, divides lower down into two branches, called the *bronchi* (Fig. 84). The bronchi are divided again and again into smaller branches called *bronchial tubes*. This is like the branching of a tree, and each tiny branch ends in a bunch of air sacs. The lungs are made up of these tiny air sacs, and these provide the surface required to expose blood to the air. If you could spread the little sacs out flat, they would measure a space as large as ten feet square. The walls of these sacs are very thin indeed, and in these walls are many tiny

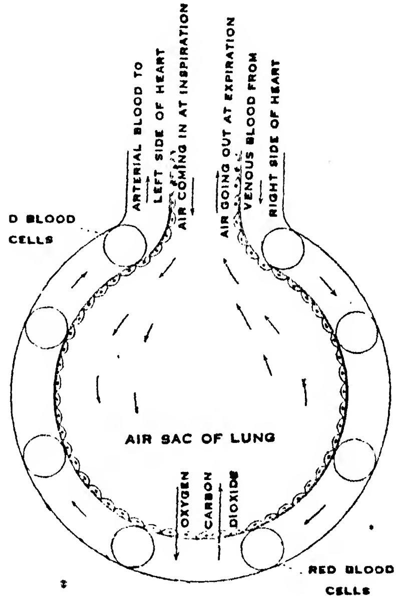

Fig. 85

Diagram of respiratory mechanism in lung showing how the blood comes in contact with an air sac and thus receives oxygen and gives up carbon dioxide (modified after Adami and Nichols).

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

capillaries. Do you remember what a capillary is? If you cannot recall how the blood reaches the lungs, look back and see what was said of the artery which carried the blood from the right ventricle. Then trace this again in the diagram (Fig. 85). It is important that you keep the circulation of the blood in mind while we are studying respiration.

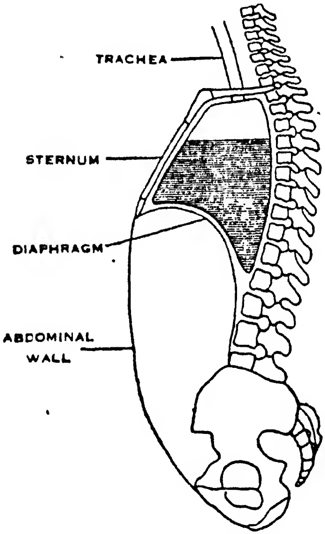

Fig. 86.—Inspiration

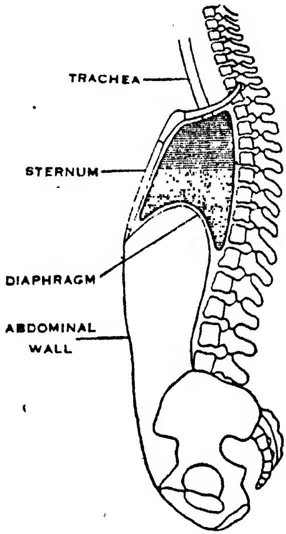

Fig. 87.—Expiration

Diagrams to show the positions in respiration of the sternum, diaphragm and abdominal wall

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

The *lungs* lie in the *chest cavity* which is separated from the *abdomen cavity* by the strong muscle called the *diaphragm*. It curves up under the lungs like a 'Siva' dome, and is attached to the lower ribs at the side, and to the vertebræ behind. This is the most important muscle of the respiratory system. When the diaphragm contracts it

flattens and descends, letting the lungs descend also. The lungs then fill with air which expands the air sacs. When we breathe out the air the diaphragm rises up again into a dome shape, thus pushing the air out of the lungs (Figs. 86 and 87).

There is another way by which we can make the chest larger to admit air. This is by lifting the ribs. You can feel them rise and fall as you breathe, if you put your hands on your sides. There are little muscles between the ribs, so attached that they can pull the ribs up and out. When the ribs sink down again, this forces the air out of the lungs. We should use both methods of expansion in natural breathing. Sometimes girls and women tie the string which supports their skirt too tightly, or boys wear the belt of their trousers too tight, and this prevents the outward movement. It is better to *hang all clothing from the shoulders.* If we sit with our shoulders rounded, this cramps the chest and does not permit it to expand. How many inches can you expand your chest? Try measuring the chest after the air is expelled; then expand it, by breathing in a deep breath, and see how many more inches of tape are required to reach around your chest when the lungs are full of air.

See now if you can tell the story of how we breathe. When we expand the chest, *air* rushes in through the nasal passages, down the trachea, through the bronchial tubes, and into the air sacs at the end of them. The *blood* in the meantime has come from the right ventricle of the heart, through the pulmonary artery, and has been spread out through the tiny capillaries, in the thin walls of these air sacs, in the lungs. The *oxygen,* which is in the air, passes through the thin walls and enters the blood, being held in the *red corpuscles* by a substance which contains iron. The carbon dioxide gas, which the blood has brought from the cells of the body in the red corpuscles, is at the same time

released and allowed to pass through the walls of the capillaries and tiny sacs into the air (Fig. 88) which we breathe out of our lungs as we relax the ribs and diaphragm. *Regular deep breathing* is therefore necessary, to give the lungs plenty of fresh oxygen to supply the blood and to carry away the poisonous carbon dioxide. The blood is in this way purified and returns to the heart by the pulmonary vein, entering the left auricle. The beating of the heart forces the blood into the left ventricle and then out into the aorta artery, which starts it on its way all over the body with its precious load of fresh oxygen for the cells. The oxygen travelling over the body in the red corpuscles of the blood stream leaves the red corpuscles behind, and passes out through the capillary walls to the cells. The cells burn their food with the oxygen which is thus brought to them, releasing carbon dioxide. This must then be carried back to the lungs and eliminated by breathing. Unless the cells get the oxygen they cannot burn the food, and it cannot support

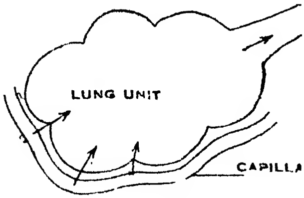

Fig. 88

Waste from the blood eliminated by the lung

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

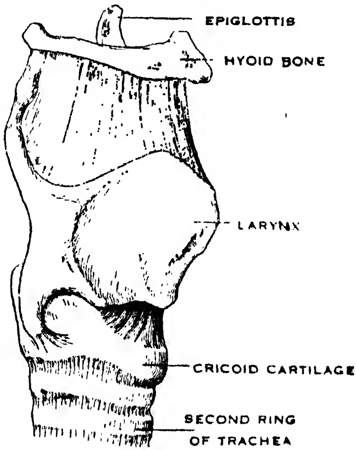

Fig. 89

View of the right side of the larynx from the front

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1912).

life. We can live longer without food than we can without oxygen. Let us, therefore, be careful to keep our lungs supplied with this gas which is free to all.

The voice. Voice is the sound produced in the larynx when we breathe outward and set the vocal cords in vibration. You have already learned where the larynx is situated. Perhaps you can feel it if you press your fingers to your throat. Often it is so prominent in men's throats that you can see it very easily. The larynx, or voice-box (Fig. 89), is made of ridge-shaped cartilages, or ligaments, joined in front to form

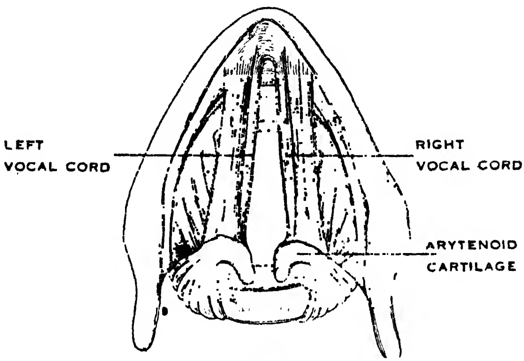

Fig. 90

Cross-section of the larynx above the vocal cords with the mucous membrane removed

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

the sharp point which you see in a man's throat. There are two elastic cords, or ligaments (Fig. 90), projecting into the cavity from back to front, and attached all along one side. The space between the cords is called the *glottis.*

In ordinary breathing the glottis is V shaped; but in order to produce the sound of the voice the muscles stretch the vocal cords tighter, which at the same time close the the glottis by bringing the cords closer together. When we expel a blast of air, the edges of the cords are made to

vibrate. You have learned about *vibration* in a previous lesson and will understand that, when the edges of the vocal cords vibrate, they pass this vibration on to the air in the passages above. When we are breathing in an ordinary way the glottis is about half open; when we breathe deeply the glottis widens; but when we speak or sing the glottis becomes a mere 'chink': it is so nearly closed (Fig. 91).

The more force with which we expel the *breath* the *louder* will be the sound. It is important for us to breathe

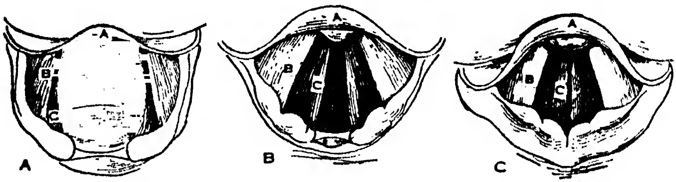

Fig. 91

The mouth of the larynx viewed from above. A shows the position of vocal cords; C in deep breathing; B is their position in ordinary breathing; and C shows them brought together for speaking or singing. A is the epiglottis.

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

and stand correctly, if we are to control the breath in speaking and singing and to enunciate plainly.

The *pitch* of the voice depends upon the length of the vocal cords. If you play on a musical instrument you can answer these questions. Is the pitch higher on a long or a short string of the harp, vina or bin? Is the string of these instruments, or of the guitar or dilruba, tuned up or down by tightening it? Which makes the higher note, the light or the heavy string in these or the violin or sarangi?

The pitch of the note given by a string can be raised in three ways: by *tightening* it, by *shortening* it, or by *decreasing* its weight. The vocal cords of women are about one-third shorter than those of men, so you can understand

why women's and children's voices are pitched higher than men's. Boys' voices 'break' and 'change' as they grow to manhood, because their larynx enlarges and the vocal cords become longer.

The *quality* of the voice depends upon the way in which the sound is strengthened and modified by the vibrations of the walls of the lungs and trachea below, and the nose and mouth above. You know how the sound made by the vibrating strings of the violin or dilruba and sarangi are given a peculiar quality to their tones according to the

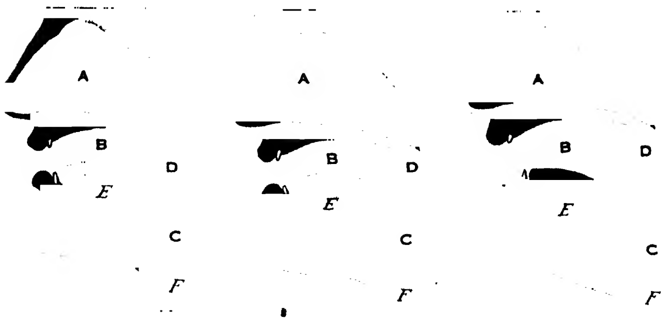

Fig. 92.

The resonant chambers. A, resonance cavity of the nose; B, resonance cavity of the mouth; C, resonance cavity of the pharynx; D, soft palate; E, tongue; F, point at which vibration begins

The figure on the left shows soft palate (D) in normal position, allowing air in naso-pharynx to vibrate in unison with initial note. The middle figure shows soft palate raised, shutting off the resonance and rendering tone thin and hard. The figure on the right shows another common fault. The tongue is lowered, increasing the size of the mouth cavity. This increases the volume of the tone, but renders the quality harsh and hollow (Latson).

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

shape and material of the instrument; so the shape and condition of your throat and nasal passages influence the quality of your voice (Fig. 92).

The quality of the voice is spoken of as its *timbre*, and depends upon these overtones or harmonics. The voice is

modified by the passage outward of the sound through the adjustable cavities of the pharynx, mouth, nose, and becomes *speech*.

We see that sound formed by the vibrations of the vocal cords in the larynx is transferred to the air, and is modified by the cavities and the positions of the tongue and lips, so that speech is formed. The way in which sounds are classified and produced belongs to the study of phonetics.

Experiment 32. *To see how the shape of the nasal passages influences the quality of your voice*

Let one member of the class stand at the back of the room, where she can be heard but not seen. Let her read out loud, and at some time, without pausing, let her close her nostrils. See if the others can tell at what point she did this. Does it change the quality of her voice?

Experiment 33. Open your mouth as wide as possible; look into a mirror and try to see the two holes leading from the back of the nose into the back of the mouth and down the funnel-shaped cavity of the throat. What is this cavity called?

Experiment 34. Count how many natural breaths you take in a minute. Now take deep breaths and count the rate per minute.

Respiratory diseases. We have studied about the blood and the red and white corpuscles which it contains. We have spoken of the way in which the disease parasite of malaria gets into the red corpuscles. We have also mentioned the way in which white corpuscles of the blood endeavour to destroy the pus-forming germs.

These *white corpuscles* are like little soldiers battling for our lives. They destroy the germs by eating them. The man who discovered this process was Metschnikoff, and it helps us to understand how the body is able to overcome disease. We have also learned that the body can secrete a *protective substance* which counteracts the poisons secreted by the germs. Our bodies are indeed wonderful in their

ability to withstand the inroads of so many enemies to our health. But it is our purpose to learn how to keep the body in a condition that will enable it to *withstand* infection of every kind.

How wise were the lawgivers of old, who made rules for us, governing the necessity of *washing hands* before eating; using only our own, known *water-supply*; never touching the lips to the cup when *drinking*; and not *eating* food which others have handled. If these rules were *obeyed in the true spirit* we would have far less infection from communicable diseases. But we often obey merely the 'letter of the law', and think if we have poured water over our hands they are clean; if we accept water only from one of our own caste we think it is safe, without looking to the original source of supply; and we accept food from one of our own people, even if flies have been crawling all over it.

Colds and *catarrh* are so common with us that we fail to realize they are germ diseases and that they can be spread from one to another. We have been so accustomed to hearing the sound of coughing and clearing throats in the morning that we scarcely notice it. But we need to be more careful in the disposal of the *mucus* which is thus coughed up from our throats and blown from our noses. Germs can grow in the lining of our noses and throats, and there they cause inflammation which is called a *cold*. When a cold becomes chronic, that is constant, we say we have *catarrh*. This condition of cold may not be acute, but it is weakening to the body and may cause you to be more *susceptible* to other infections, like tuberculosis and influenza.

The germs of these diseases are scattered in a similar way to that of colds, that is, by means of the mucus which is coughed from our throats. If we spit on to the ground, or elsewhere, the germs are scattered, and when dried may be breathed into the lungs and air passages by other people.

More than this, the sputum (mucus) which has been expelled by the person suffering from *cold*, *catarrh*, *influenza*, *pneumonia* or *tuberculosis* may lie exposed where *flies* walk over it. The flies eat it and walk in it, getting germs on their legs. They then fly on to the food in the bazaar, on to the sweets and the fruit exposed for sale. They leave their spots containing germs and also the germs which are carried on their legs. Is it any wonder that when we eat the food we contract disease? *Dirty hands* are also one of the most common means of distributing bacteria and spreading infection.

While the germs may be introduced in other ways than by breathing them into the air passages, yet it is in the air passages that the germs of tuberculosis lodge. When they get into the lungs and begin to grow upon the living tissue, they produce the form of tuberculosis called *consumption*. You can see from all that has been said, that the most important means of preventing this disease, which is becoming more and more prevalent in India, is properly to dispose of the mucus which is expectorated by people who are sick with the disease. And since many people may carry the germs for a long time before they realize that they have the disease, don't you think we should take more pains in disposing of this waste mucus in a sanitary way?

How should we dispose of the mucus (sputum) which we cough and spit up? One way is to use pieces of paper, or even a leaf, into which the mucus can be dropped, and then the paper or leaf *can and should be burned* as soon as possible, before the sputum has had a chance to dry. Another way is to have little mud dishes, or paper cups with covers, into which the mucus is dropped (a disinfectant, such as permanganate of potash, may be put in the bottom). The dish must be kept covered. When filled it should be burned or buried at least a foot below the surface of the earth.

The other chief way in which consumption is spread is by means of *impure milk and butter.* It is possible for cows to have tuberculosis, and the germs of the disease are frequently found in the milk of cows. Other germs are also carried by milk. It becomes of especial importance, therefore, that cows be properly looked after. Doubtless the early Hindu law-givers realized the necessity of caring for the cows in a sanitary way, and that is why they imposed it as a *sacred* duty. Here again we obey the letter rather than the spirit of the law and, while we *worship* the *cow*, we neglect her and fail to keep her *clean* and to *feed* her and *shelter* her properly. Consequently she is made ill with tuberculosis. Then we drink the milk and give it to the sick and to the young, and they are infected with disease germs. Not only does the cow need care, but the *milk*, too, requires the most scrupulous *cleanliness* in its handling, or other germs, such as those of typhoid fever or *cholera*, will surely get into it. The *open cans* delivered by rail, and the brass *lotas* carried on the heads of coolies through the streets, amid the dust of the town, are ways in which the milk is contaminated. The *dirty hands*, the *dirty chatties*, *dirty grass* stuck into the mouth of the *chatti* and *dirty water*, used not only to wash the vessels but to dilute the milk, all offer opportunity for disease germs to get into the milk. We should try to get milk from as clean a source as possible and to take good care of the cow, if we own one. The cow will fully repay good care, by giving us more and better milk.

The only safe thing for us to do, when we cannot control the source of our milk supply, is to heat the milk to destroy any germs in it. You may *pasteurize* it, that is, heat the milk to the temperature of about 140° F., and keep it at that temperature for twenty minutes. Then cool it quickly, by standing the jug in cold running water. In India it is safer and also easier for us to bring the milk to the boil and cool it quickly.

Butter, too, can carry these germs, and our custom of boiling the butter into ghee is based upon scientific grounds. Since boiling destroys the germs in the butter, it has been proved by experience that ghee will keep without spoiling.

Consumption is most often conveyed from person to person and, therefore, it is very important for us to know how to care for anyone who has the disease. Patients should not eat with others, and their trays, cups, etc., should be washed separately from the others. Indeed, it would be wise for them to use a plantain leaf and leaf cups which can be burned after eating. They are apt to spread the disease germs on their hands and, therefore, a separate room should be made for them, where plenty of sunlight and fresh air is to be had. Sunlight is the best disinfectant we have, and our blessed Indian sun is what saves us, in spite of our careless habits, from being exterminated by disease.

The patient should have his own mat and bedding, and it should be sunned regularly and washed separately from others. His room and bed should be screened from flies and mosquitoes. He should have good nourishing food. The milk should be boiled, and the sputum should be burned. If we take such care of our sick we will prevent the other members of the family from getting the disease, and also it will be possible for the patient to recover health again.

Many disease germs gain access to our bodies through the respiratory passages. We might even call the nose and mouth the 'gateways of our health'. Statistics show that as many as one-seventh of the entire number of deaths is due to lung disease alone. You will now see the reason for learning to take intelligent care of the respiratory system. You remember that mucous membrane lines all the cavities of the body, including the respiratory tract. Hairs in the nostrils help to sift out dust and prevent its entrance to the trachea. The cilia (Fig. 93), or hair-like processes of the epethelium cells, line all the passages exposed to air. These

are in constant motion like sweeping and so are able to remove dust from the lungs to the larynx where we can cough it up. The cilia are not able to remove all the dust however, and therefore germs reach the lungs on the dust particles which escape their activity. You can see how important it is for us to keep our houses clean, and not to scatter dry dust by improper methods of cleaning our rooms. The nose is so constructed that the bones and processes form an intricate passage and is, of course, lined with moist mucous membrane hairs and cilia, through which the air must pass before reaching the trachea. It is plain that such air will be better *warmed* and *cleaned* than that which we breathe in through the mouth.

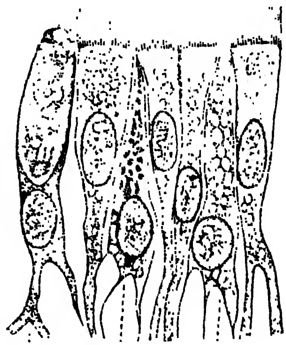

Fig. 93

Ciliated cells from the trachea of a rabbit, highly magnified. A, B, C, mucous cells in various stages of secreting mucus.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

It is very important for us to do our breathing through the *nose*. A mouth-breather is far more subject to disease. Children with such troubles as enlarged adenoids and catarrh develop a very unpleasant facial expression. Their n o s t r i l s remain small, their mouths stay open, jaw recedes and teeth become prominent. The mental capacity is also diminished.

Colds. What are some of the diseases which we contract through germs which gain entrance with the air we breathe? Infections of the upper air passages are caused by many kinds of germs. When the attack is mild we call it a common cold. *Colds* are very contagious, and if people with colds would take greater care and keep away from others they would save much trouble.

To avoid colds and the many diseases of which they are the precursor, we must build up a strong constitution which can resist the germs. Our bodies can be trained to endure ordinary changes of temperature and throw off infection, and it is our duty so to train them.

The *health habits* must be carefully formed and followed, such as breathing through the nose, brushing the teeth, taking cold baths, wearing clothing and using bedding which maintain for us an even temperature day and night, taking plenty of exercise out of doors, getting plenty of sleep with the windows open, avoiding overwork, and keeping cheerful. Anything which builds up the vitality will help us to resist infection.

Our Indian habit of taking a daily *cold bath* is excellent. We know that the skin is a heat regulator and ventilator. We must keep the pores open or the skin cannot do its work. At the same time we must avoid causing chill. The body should *react* from a cold bath with a warm glow, otherwise the bath is not beneficial. Can you explain how this happens? The cold water drives the blood to the internal organs of the body, stimulating the circulation and driving the blood to the skin again, thus causing the sensation of warmth.

The difference between the day and the night temperature in many parts of India doubtless accounts for the chilling of the body at night. Also the great heat of the day tends to keep the skin relaxed. This lowered condition of vitality is favourable to the growth of the germs, causing colds and pneumonia. Eucalyptus oil may be taken on sugar, three or four drops at a time, or it may be inhaled in a handkerchief or dropped in hot water, and the vapour inhaled to relieve the tightness of an approaching cold.

Habitual colds may be a *sign* or *symptom* of many other affections, such as rheumatism, adenoids, measles, influenza, diphtheria, croup or whooping-cough.

Sore throat may be a sign of scarlet fever, diphtheria, tonsilitis or quinsy.

Fever may be a symptom of stomach or bowel trouble, middle ear disease, pneumonia, typhoid, tuberculosis or malaria. The doctor's advice is necessary to determine the *cause*.

Tonsilitis. There is one micro-organism which is the root of many troubles and is especially concerned with sore throat or tonsilitis. This same germ is carried by the blood to the joints causing rheumatism, to the heart causing valvular heart-disease, and probably to the brain causing chorea. *Streptococcus* is the name of this germ which shows itself in the tonsils and grows about the roots of the teeth. It not only attacks the joints, the brain and the heart, but also the kidneys, causing Bright's disease. Now one of the chief ways in which this germ reaches our throat is through infected *milk*. Tonsilitis may pull one down as much as pneumonia, for the germs race all over the body, and the fight of the leucocytes to destroy them takes time.

Quinsy is a type of tonsilitis and is characterized by a deep abcess in the throat. It is very painful, but not more serious than tonsilitis. You will remember there are four tonsils in the throat. We do not know their use; but when they become diseased they may block the nasal passages. This causes mouth breathing, the evil results of which have been discussed. If this occurs, or the child is subject to frequent ear-aches and frequent sore throats, it is wise to have a practised *surgeon remove them*.

Words ending in *itis* imply inflammation. An inflammation of the larnyx is called *laryngitis*. It produces hoarseness and even loss of the voice. *Chronic bronchitis* is rare, and when chronic it is really *tuberculosis* or *heart-disease*. Children suffer from *acute* bronchitis.

Do not get into the habit of taking drugs to stop a cough. When you cough the body is attempting to get rid of the

disease. It is best to use *iodide of potassium* which will assist in bringing up the mucus.

Influenza is due to germs of a special kind. It is a *very bad* cold, highly infectious. Those who recover frequently suffer the results in their joints, lungs, heart, kidney or ears. It may result in pneumonia and is often fatal.

Pneumonia is an acute germ disease which itself lasts no longer than ten days. If the symptoms last longer, consumption is probably *the cause*. Good nursing and *fresh air* are the chief cures. It is three times as fatal to people who habitually use alcohol as to others. Our chief aim should be to build up our power of resistance.

Whooping cough. It is necessary, with young infants who may contract this disease, to guard them against choking. Fan them in the face with fresh air. Bathe carefully to avoid chill and keep out of a draught. Pneumonia may follow or accompany this disease.

If *vomiting* is persistent and food eaten is lost, he should be fed again soon after, otherwise he will grow weak from lack of nourishment. Give water freely. Sometimes a band pinned tight about the abdomen will support the muscles when coughing and prevent rupture.

The matter coughed, or vomited up, should be coughed in cloths or pans and *burned*, as it contains the germs of the disease. The patient should be isolated for five weeks at least, or until whooping ceases. Sometimes inoculation is used successfully as a cure.

Emergencies. It is a good thing for us to be prepared for emergencies. Often there is no time to secure a doctor, and we must keep our heads and take charge of the case.

Choking. Sometimes, when in the act of swallowing food, the person laughs or coughs, thus letting the food slip by the epiglottis and enter the trachea instead of the esophagus and causing them to choke. Usually a thump on the back, with the head bent forward and arms lifted, will be

sufficient to dislodge the obstruction. If he will cough, sometimes that will bring it up. If the choking persists, force your forefinger as far down the throat as you can; but avoid forcing the obstacle further down. Try to pull it out. It will not do any harm, but rather assist, if you cause vomiting. Continue the back thumping until the person is relieved.

If a child *swallows an article*, such as a button that sticks in the throat, hold him upside down and slap him on the back. Sometimes you can pull the article out with forceps. If breathing ceases, try artificial respiration (to be described later) and send for the doctor at once.

Drowning. Everyone should know how to swim. We should also know how to revive anyone who has been under water. We *drown* because the water cuts off the air from our lungs. Therefore, our aim must be to *get air into the lung as quickly as we can.* First, drain the water from the lungs, by lifting the patient, *face down* and jerking the body *repeatedly* and *quickly* (Fig. 94).

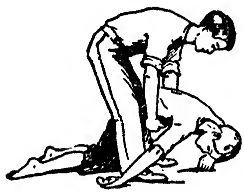

Fig. 94

Draining the water from the lungs

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

A heavy person may be rolled over a barrel. The next thing is to fill the lungs with air. Make a pillow of anything available and lay the patient face down, with the pillow under his chest. Loosen the patient's garments at neck and waist. *Act quickly.*

Now we are ready to start *artificial respiration.* See illustration (Fig. 95). Stand or kneel astride the patient, and place your hands over the lower ribs on each side. Press down steadily, with the weight of your body on your hands, to drive the air out of the lungs. Then relax the pressure without removing your hands, thus allowing the air to come

into the lungs again. Again press the air out, and again remove the pressure, but not the hands. Repeat this action fifteen times a minute and keep it up until he revives. Do not give up hope under *two hours* at least.

If there is someone to help, let him rub the limbs along the veins, in the direction of the heart, thus forcing the blood to circulate. Keep the body *warm* in any way you can, with blankets, hot water bottles, or hot stones wrapped in cloth, or hot sand in a bag. Place one at the head, but avoid having it too hot.

When the *patient* begins to revive and can swallow, let him drink strong hot coffee. A little alcohol, or sweet spirits of ammonia in water, are good stimulants. Change his clothing and keep him warm.

Fig. 95

Starting artificial respiration

(From *Human Physiology*, by Dr. J. W. Ritchie. World Book Co., New York, 1913.)

In *suffocation* the same trouble exists—lack of oxygen in the lungs, and therefore artificial respiration is necessary.

Whenever by reason of shock, asphyxiation or choking, breathing ceases, one should try restoration by this means.

Exercise 4. Let one student lie flat, and others practise artificial respiration. All should know how to do this.

When poisonous gases have been inhaled, remove the patient to fresh air and sprinkle cold water on the face.

In electric shock, if the patient is touching a wire or electrified rail, cut off the source of electricity, if *immediately possible*. If not, remove the patient. As you already know, the human body is a conductor of electricity, so that your body, touching the patient's body while touching the source,

will, especially if you are standing on the earth, immediately become electrified and, far from helping the patient, you will fall unconscious and need help yourself. Therefore, yourself standing on wood, or a dry coat, a rubber coat, or some layers of dry newspaper, push his body away with a dry stick, or pull it away quickly with your hands thickly covered with some dry, non-conducting material—rubber cloth, dry cloth or newspaper. If you want to cut the wire, cut on both sides of him with an axe with a dry wooden handle. Read up Chapter XIV in Part I and remember that there is no need to be afraid of electricity if you only remember the rules. When the patient is disconnected from the source of the current, you can handle him without danger. Then treat with artificial respiration.

A person struck by lightning may be treated at once with artificial respiration. Sometimes pouring buckets of water on the body of lightning-struck animals is a help.

In *all* cases when artificial respiration is tried, smelling salts may be applied to the nose, and the chest may be flicked with a damp cloth.

AGENDA

Oral and Practical Work

1. What is the object of respiration ?
2. Why do we require oxygen ?
3. In what two ways do we enlarge the chest ? What happens when this is done ?
4. How is the air forced out of the lungs ?
5. What is the use of mucus and cilia in the nasal passage ?
6. Why is mouth-breathing harmful ?
7. How is the voice produced ?
8. Upon what does the pitch of sound depend ?
9. What three important factors produce the sounds of the voice ?
10. Why is a man's voice lower in pitch than a woman's voice ?
11. What makes a boy's voice change in pitch ?
12. How do we make our voices loud or gentle ?

13. How do we tell one voice from another, when both are singing with the same pitch and loudness?

14. What would you do if food entered the trachea instead of the esophagus?

15. How do we 'take cold'?

16. What is the cause of consumption?

17. How are these diseases spread?

18. What is necessary to prevent infection?

19. What care must we give those sick with these diseases?

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CHAPTER VII

THE DIGESTION

'Now good digestion wait on appetite, and good health on both.'—*Shakespeare*

Required.—Litmus paper, tincture of iodine, nitric acid, ammonia, rock salt, chuna, soda bicarbonate, cornflour, maida or atta, potato, sugar, sour lime, tamarind, curds, egg white.

Why do we have to eat so often? What happens to the food after it is eaten? Does it make any difference what we eat?

When you place rice, dhal, ghee and chapatti on your tray, with perhaps cooked vegetable and koshimbeer, it causes your mouth to water. The *odour* and *appearance* of the food is appetizing, and so you carry it to your mouth, chew it and swallow it. After that you are unconscious of what happens to it. You probably do not realize that after the food is swallowed, it is still anatomically and physiologically outside your body. Nevertheless this is true. Continuous with the skin is the mucous membrane which is the inner lining of the *alimentary canal.* The *mucous membrane* is made of epithelial tissue and secretes, among other substances, a mucus which prevents friction. The *inner coat* is of *connective tissue,* and its work is to toughen and strengthen the wall and to bind the mucous coat to the muscular coat. The outside coat is made of two layers of *involuntary muscular tissue* which is able to move the food along by its power of contraction. The food must *pass through this mucous membrane* before it can be taken up by the body tissues and become of any use to us; until it has passed through the membrane, it is as much outside your body as though held in your hand.

The alimentary tract is a long passage-way through the body, divided into *mouth*, *throat*, *esophagus*, *stomach*, *small*

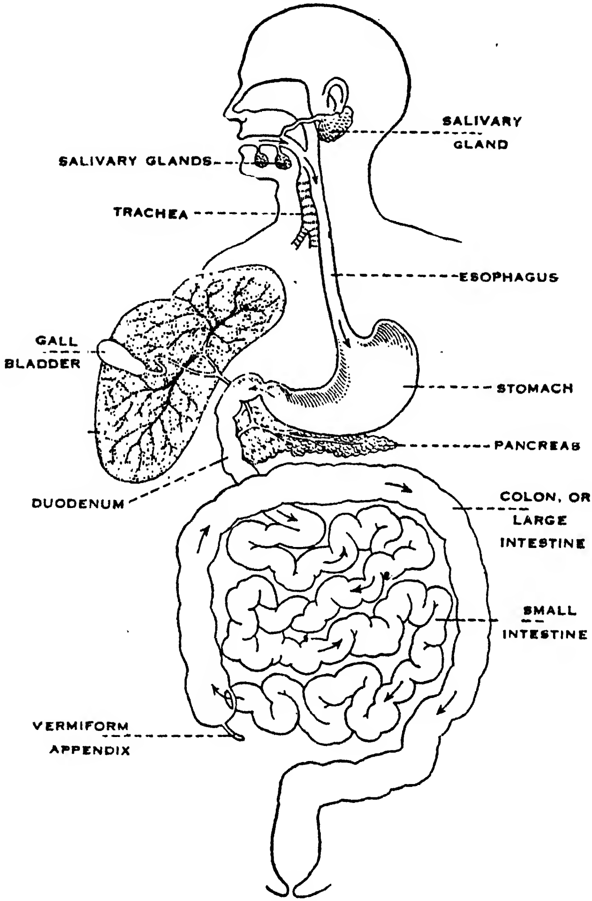

Fig. 96.—The digestive system

The food materials must pass the mucous membrane lining of the alimentary tract before they are *within* the body. The liver is displaced upward to show the parts under it.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

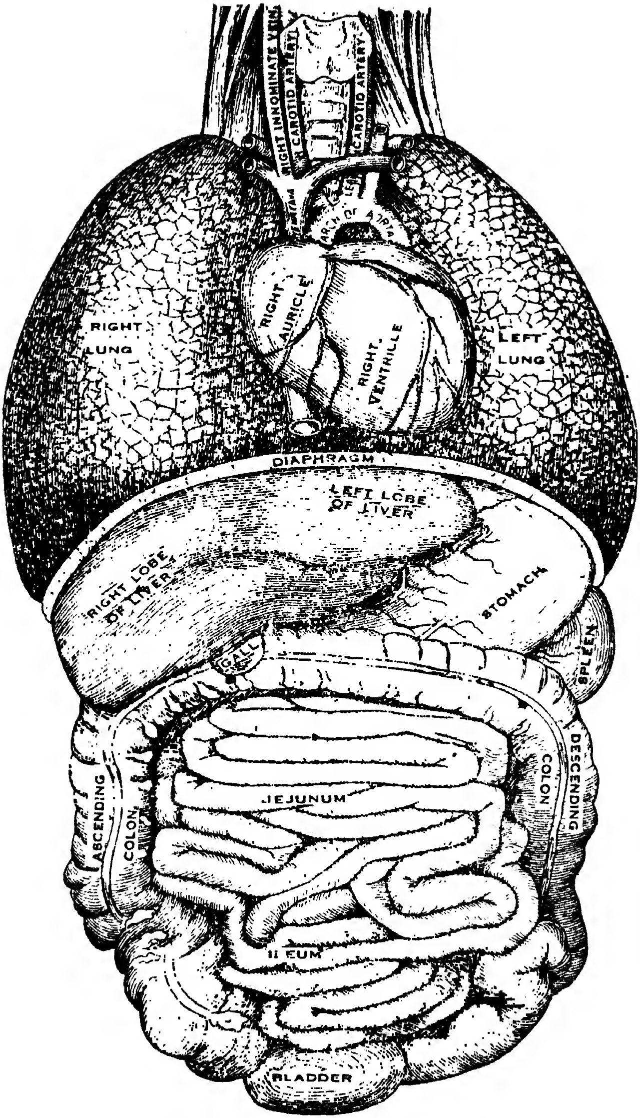

Fig. 97.—The organs of the trunk

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

intestine and *large intestine* (Fig. 96). The other organs of digestion are the *teeth*, *salivary-glands*, *liver* and *pancreas*. The stomach, pancreas, liver, spleen and intestines lie below the *diaphragm* in what we call the *abdominal cavity*, as you can see in Fig. 97.

When you put some rice into your *mouth*, the *teeth* take it and grind it into small particles. The finer we grind it the more quickly it will dissolve and be digested.

Experiment 35. You can prove this by taking a lump of rock-salt and placing it in water. Then grind some of the salt between stones and place it in water. Which has dissolved more quickly? If you taste the water in which the salt has been dissolved, you will find that the salt is in all parts of the water. This is because the salt molecules have been separated and scattered all through the liquid.

The *teeth*, as we have previously learned (page 87), are constructed according to the work they have to do. If we had no teeth we would either have to mince the food before eating it or swallow it whole. They are useful, therefore, in cutting and grinding our food so as to make it more easily soluble and more readily digestible. *Indigestion* is often caused by swallowing food without properly masticating (chewing) it. Hard foods are especially valuable for giving exercise to the teeth and *keeping the gums in a healthy state.*

The *tongue* helps us in chewing our food by pushing it back and holding it between the teeth. While chewing the food we also mix it with a watery fluid called the *saliva*. This fluid is secreted by three pairs of glands. The *glands* look like tiny bunches of grapes with a hollow stem. The pair of glands which lie beneath the skin in front of the ears are the largest. These are the glands that swell in *mumps*. Two other glands are under the back corners of the lower jaw, and the two smallest glands lie under the tongue. Acid foods are beneficial as stimulants to the secretion of saliva. What happens if you look at, or even

think of, a sour lime? The fluid from these glands mixes with the mucus from the lining of the mouth and also with air. If you put some in a glass test tube and examine it, you will find it is thin, colourless, sticky and contains air bubbles. Let us test it with a piece of litmus paper.

Experiment 36. You have already learnt (Part I, p. 83) what litmus will do under certain conditions. If you have some lime (chuna), put it into water. This is a compound formed when the metal calcium unites with oxygen. It is, therefore, a base; for 'bases are compounds of metals formed when a metal combines with the oxygen of the air'. When you dissolve a base in water it results in what we term an *alkali*. If you put the red litmus paper into this alkali, you will note that it is turned *blue*. This is, therefore, a test for an alkali. Now test the saliva in the same way. Is it alkaline? Test other things in the same way, such as sugar, soda, and determine what things are alkaline.

The saliva contains an agent secreted by the glands, which has a wonderful power over starchy foods. This agent belongs to a big family called *enzymes*. They are like *keys* which alone can fit into special locks. The 'key' found in saliva is called *ptyalin*, and it can unlock the starch molecules and produce what we call a double-sugar (maltose), but it can act only in an alkaline or slightly acid medium.

You must realize now how important it is for us to chew our food thoroughly. If it is well mixed with the saliva and broken up into a finely divided form, the ptyalin can unlock most of the starch units during the early stages of digestion. You can see, too, why it is wrong to swallow large mouthfuls of rice without thoroughly *chewing* it. There is starch in the *rice*, in the *dhal* and in the *wheat* of which the chapatti is made. This you can easily prove if you want to.

Experiment 37. Take a little cornflour and maida or atta. Boil each separately with water, and cool. Then

dilute some *iodine* with water. Note the colour of the iodine is *golden brown.* Drop some of the iodine into the mixtures of corn and wheat flour you have made, and note what takes place. You can make this test on many foods, such as potato, and see whether they turn *violet-blue* as the flour does. This is a sure test for starch. We will learn more of this class of foods later. Hard foods, such as chapatti and pulka, or toast, are good for us to eat, as they require chewing and cause the saliva to flow. It is also a signal for the stomach to make ready for what is coming and prepare for duty.

After the food has been chewed, the *tongue* pushes it back and it is swallowed. The muscles in the back of the mouth and the walls of the *esophagus* contract above the food and press it downward into the stomach, as the hand squeezes the teat of a cow's udder in milking and presses the milk downward into the chatti.

This contraction forces the food before it, as if a tight ring were slipped down over the esophagus. A contraction of any part of the alimentary canal in this manner, as if a wave were travelling along, is called *peristalsis.* While a horse is drinking water, you can plainly see the peristaltic waves along the neck, as the water progresses.

The stomach. The esophagus enlarges just below the diaphragm into a pouch, called the stomach. It lies a little to the left side of the abdomen. When empty, it is quite small, but it can hold from three to four seers (lbs.), and when full it measures about a foot long and five inches broad. It acts as a storehouse for the food we eat, so that we can take enough food to last us for several hours. If we had no stomach, how often do you suppose we would have to eat? The end of the stomach where the food enters from the esophagus is called the *cardia*, because it is near the heart. The opposite end, which opens into the small intestine, is called the *pylorus*, which means gatekeeper. Both openings are closed by circular muscles.

In the inner coat of the stomach wall are a large number of *gastric glands* (Fig. 99). These glands are like tiny holes pushed into the walls of the stomach, such as you can push with your finger into dough when you are kneading it for chapatti. The glands are all formed by folding the inner layer of the stomach wall into these narrow pockets. They are very close together, and you can imagine how small they are, for they do not reach more than half-way through the wall, though the wall is no thicker than cloth.

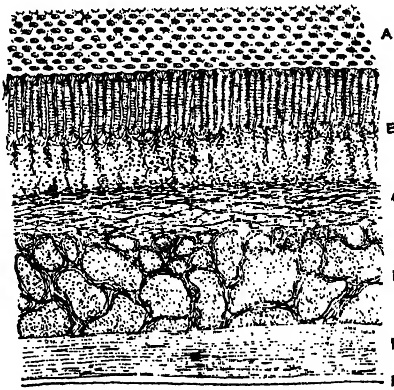

Fig. 99

A section through the wall of the stomach. (Magnified 15 diameters.) A, surface of the mucous membrane, showing the openings of the gastric glands; B, mucous membrane, composed almost entirely of glands; C, submucous, or areolar, tissue; D, transverse muscular fibres; E, longitudinal muscular fibres; F, peritoneal coat.

(From *Healthful Living*, by Dr. J. F. Williams. Macmillan Co., New York, 1921.)

These tiny glands secrete the *gastric juice*. This juice also is clear and watery like the saliva, but, unlike the saliva, it is *acid*.

Experiment 38. You will now want to know what an acid is. Acids taste sour and have the power of dissolving metals. They change the *blue* litmus paper *red*. You can prove this by putting the blue litmus into the juice of sour lime or narangi or tamarind. Try other things also.

The acid of the gastric juice kills bacteria which may be taken into the stomach with the food, and so prevents them from entering the intestines and making trouble for us. The gastric juice contains a substance which is an *enzyme*,

or key, called *pepsin.* This key would not fit into the same lock that the key in the saliva fitted, but it will, in the presence of hydrochloric acid, unlock the *protein* molecule and split it into smaller units.

Now you will ask what is *protein*? There are tests for protein foods just as there was a test for starchy foods. The wheat flour of which the chapatti was made, the dhal, and the curds all contain protein, and we will learn more about them later. Try this experiment for protein.

Experiment 39. Put some curds, or the white of an egg, into a test tube. And add some *nitric acid* very carefully. Heat it gently to boiling, and then cool. Note the appearance of a yellow colour. Add some *ammonia*, and if it turns a *deeper yellow*, or *orange*, it contains *protein.* You can now try this test on other substances. Later we will learn another test for protein.

The ptyalin of the saliva could not unlock the protein molecule. The pepsin cannot unlock the starch or fat molecule. The *stomach* walls contain three layers of muscle fibres. One layer runs lengthwise, one runs around and the third obliquely. When the stomach is filled with food, the muscles contract and the food is churned back and forth, up and down, thoroughly mixing the food with the gastric juice. As portions of food near the pylorus become acid, the circular muscle at the pylorus opens and lets the acid portions pass into the small intestine.

The *small intestine* is a tube about an inch in diameter. It is very long, though, and is coiled up in the abdomen. The food passes only slowly through the twenty feet of its length. Along the inner walls (Fig. 100) of the intestine are *glands* like those in the stomach, which make juices to digest the food. Other juices flow into the intestine from the *pancreas* and the *liver*, and here the digestion of all the food is completed. The lining of the intestine is wrinkled into folds so close that they nearly cover the entire inner

surface. All over and between the folds of the lining are tiny hollow projections, like the fingers of a glove, called *villi.* They lie so close together and are so small that you would be reminded of *makh-mal* (velvet). The villi have within them tiny blood vessels and lymphatic vessels. The work of the villi is to absorb the digested food into these vessels; so the blood and lymph can carry it to the cells all over the body.

The *pancreas* lies behind and below the stomach. Its work is to make the *pancreatic juice.* This is the most important of all the juices for digesting food. It really has *three keys* and is able to unlock any starch or protein molecules that have escaped the saliva or gastric juice, and it can also unlock the fat molecules. The pancreatic juice is *alkaline.* Do you remember the test for this?

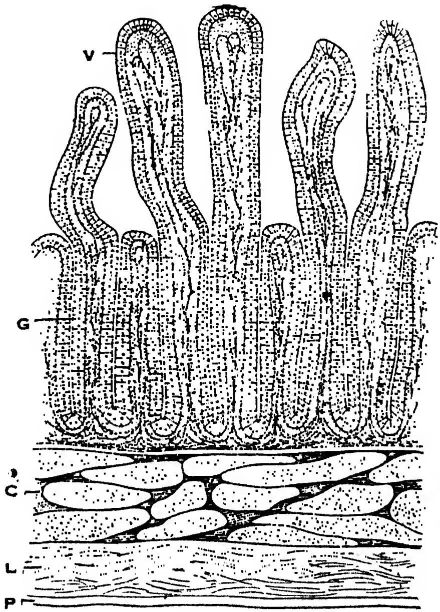

Fig. 100

To show the structure of the wall of the small intestine. V, villi, and G, glands of the mucous membrane; C, circular muscle layer; L, longitudinal muscle layer; P, peritoneum, or serous coat.

(From *Healthful Living*, by Dr. J. F. Williams. The Macmillan Co., New York, 1921.)

The *liver* lies close to the stomach, but on the right side of the abdomen. The secretion of the liver is a greenish-

yellow fluid which is very bitter and is called *bile*. The bile is stored in a sac called the *gall-bladder*. This bile is emptied into the intestine and, though it cannot digest the food, as it has no key, it can help the pancreatic juice to do its work faster. It also helps the food to pass more readily through the intestinal wall and be absorbed.

The *large intestine*. The small intestine opens into the large intestine which is about five feet long. It is drawn up by bands of muscles running lengthwise along it, making it look as if it was on a draw-string. The place where the small intestine joins the large one is just above its end, and the part below this join is called the *cæcum*. Attached to the cæcum is a small tube called the *vermiform appendix*. When certain germs grow in this, they cause the disease known as *appendicitis*.

The large intestine joins the small one in the lower part of the abdomen on the right side. Above the join, the large intestine is called the *colon*. It runs up the right side of the abdomen almost to the waist, then across and comes forward and across in front of the lower line of the stomach. Then it turns backward to the rear wall and passes downward. Near the left hip it makes a double bend like the letter S. The remainder is not puckered, but straight, and is therefore called the *rectum*, from the Latin word, meaning ' straight '.

The *waste material* from the food, which has not been absorbed (that is, has not passed through the walls of the intestine into the blood), is pushed along through the large intestine by the same muscular action which we use in swallowing. This *peristaltic action* compresses and squeezes the material and moves it along through the colon. Absorption of water in the large intestine is very active, and soon the contents lose their fluidity. All the indigestible material gathers in the part where the double bend is and descends at intervals into the rectum. It should be *evacuated* from

the rectum at regular times, usually soon after eating. It is very important that the habit of *regularity in emptying the bowel* should be established very early in life, and it should never be broken. This waste material, the *fæces*, contains millions of bacteria which cause it to decay and form poisons in it. If this waste is not promptly removed from the body, the poisons will be absorbed into the blood and the whole body will be injured. Headaches, tiredness, weakness and other disorders will result. Eating green or succulent vegetables is one good way of preventing this disease which we call *constipation*. The woody fibre of the vegetables is spoken of as *roughage*, and it acts as a broom to sweep out the wastes. Vegetarians do not suffer from constipation so much, therefore, as do meat-eaters.

Indigestion. What is an indigestible food for one person may not be so for another. Many of our ideas about foods causing *indigestion* are erroneous. Some foods require much longer to digest than others. Carbohydrates digest most quickly, proteins next and fats take longest; therefore, foods rich in fat are called *indigestible*, though what is meant is that they take long to digest. Often people who eat too rapidly or at irregular times, or too much sweet or too much starchy food such as rice, have what is called a *sour stomach*. The food ferments forming gas which distends the stomach. A simple remedy for this is to dissolve one level teaspoonful of bicarbonate of soda in one seer of warm water and drink it. No harm is done if this induces vomiting, but, whether it does or not, it will bring relief. Why?

The use of too much sugar and starch may induce diarrhœa also, and the true remedy for this, as well as for indigestion, is to select one's food more wisely.

Constipation, however, is most often the result of nervousness, or failure to form a regular habit of evacuation. Fear, worry and emotional strain may cause indigestion and constipation. The important thing is to train a child to be *regu-*

lar both in eating and in voiding wastes. If good habits are established, the adult will not be troubled by either of these difficulties. They should be *unconscious* processes, and the more one makes them habitual the better. Exercise and drinking plenty of water aid one in this habit.

There are two classes of medicine used for constipation: *laxatives*, such as cascara, liquorice powder, rhubarb, senna, liquid petroleum; and *purgatives*, such as salts, calomel and castor oil. The laxatives are mild and can be taken for a long time without harm. Purgatives are violent and should only be used on special and rare occasions. But it is much wiser to select the right food and establish right habits, so that medicines will not be required.

Diseases of the alimentary tract. The only way in which we can be infected by diseases in the alimentary tract is by eating and drinking unclean food and water. It is no wonder that the 'Lawgiver of Old' made so many rules by which we should order our living. The later work of scientists has confirmed the wisdom of the wise men of old. Let us see how this is true.

Cholera, *enteric* or *typhoid fever*, *dysentery* and *diarrhœa* are all caused through taking the germs of these diseases into our mouths, with water or food, swallowing them, and thus letting them reach the intestines where they grow and multiply. The diseases caused by these germs are, therefore, called *intestinal diseases*. About three-fourths of the people who have *cholera* die of it. The germs are very strong, and it takes but two days to develop the symptoms of the disease. The germs are able to live a long time outside of the body, if kept damp, and that is why they live so well in water and on moist food.

But how do the germs get into the water and food? That is the most unpleasant part of the story. They cannot get there except through the careless and unclean habits of those who have the germs in their intestines, or the careless-

ness of those who look after the sick. That is why it has been said that 'whenever anyone catches one of these diseases, someone else ought to be put in jail'. To be the cause of spreading disease germs is just as truly taking life as to kill with a knife or poison. We are responsible for the health of those about us. Let us learn how we may avoid causing the sickness and death of others.

Means of spreading these diseases. Some people who have been sick with these diseases and have recovered are *germ carriers*, and others who have never shown symptoms of the diseases are also carriers of the germs in their intestines. It is these people who are probably responsible for starting epidemics of disease. It is, therefore, important, especially in a hot climate, that everyone, whether sick or well, should take the greatest precautions in *disposing of the body wastes.* Any person having disease germs in his intestines, will spread them with the *excreta* (or fæces) and *urine* which he voids. This body waste should be disposed of in sanitary closets, and lime (chuna) sprinkled over after each evacuation. If the wastes are allowed to lie on top soil, or drain into open sewers, the *flies* will surely light upon them and carry away the disease germs on their legs. The flies then light upon the food in the bazaar, the fruit and the sweets that are eaten without cooking, or upon the cooked food left uncovered in the house. They rest upon the baby's face and hands, and drop into the milk. Flies are filthy creatures, and every one is an active agent in spreading germs. We should screen our food and keep the flies out of the houses, therefore, if we wish to avoid infection from these diseases.

Another way by which these active germs of cholera, diarrhœa, dysentery and typhoid fever are able to enter our bodies is in the *water* we drink. This has been spoken of in several other connexions, but these diseases in particular are carried by water. The body ejecta (fæces and urine) which are carelessly disposed of, may seep through the soil

into the tank, well or river. Furthermore, people who bathe in tanks, after attending to nature's demands, scatter germs of these diseases, which are then taken by the other bathers, and by those who drink the water or use it to wash their mouths.

Again, if the clothes of those who are sick, or carriers of these diseases, are washed in the water which others use for drinking and bathing, they, too, spread the infection. To take in germs in water is an especially dangerous way of contracting diseases, for when we drink it, it passes very quickly through the stomach, so that the acid of the stomach has little chance of destroying the germs. During an epidemic we should avoid eating indigestible food, or taking medicine like salts which will hasten the passage of food through the stomach. Since water so readily carries these diseases into our intestines, don't you think we should be extremely careful not to contaminate it? And oughtn't we to make sure it is pure before we drink it? When cholera or enteric are about, it is wise to be inoculated against them. The principles of inoculation and vaccination are explained in Chapter II, p. 39.

In the *Yajurveda*, the part called Arana, commandments are given in respect to the care of water. Also Manu, in *Manava Dharma Sastra*, says: 'Let me not cast into the water saliva, nor clothes, nor anything soiled with impurity of blood, nor any kinds of poisons.' The laws of Manu require that water should be filtered, and the Susruta gives many rules for safeguarding it against contamination.

Muddy water should be allowed to settle, and a little *alum* (six grains of alum to each gallon of water), rubbed around the inside of the vessel in which the water is stored, will cause the muddy sediment to settle, and then it can be poured off. Mud is irritating to the intestines, and muddy water should not be used for drinking. Lime (chuna) is also useful in setting the sediment.

The water should be boiled after being poured off. *Boiling* is the only sure way of destroying the germs of cholera, enteric, dysentery and diarrhœa. Boiling for five minutes will destroy all these germs. If you do not like the taste of boiled water, try pouring it into a bottle, only half filling it, and then put the cover on and shake it. The air it thus takes up will improve the taste. Or pour it back and forth from one vessel to another to aerate the water before storing it. Then if it is hung up in a breezy place in a porous chatti and covered carefully, it will *cool* and be *safe* for drinking. Remember, though, that the vessels in which water is stored are to be cleaned with *hot water*, and not with dust or ashes: also that the *water must be kept covered.*

Domestic filters are not sanitary unless *cleaned daily.* The Pasteur filter is the best; but even that is soon contaminated, and boiling the water is the safest and best method of purification.

Permanganate of potash is good for purifying wells and any other water supply, where boiling is impracticable. The rule is to add the crystals of permanganate of potash to a small amount of water (one or two ounces is sufficient for a well). Then pour this solution into the larger bulk of water until it is red. The redness should last eight hours in order to purify the water. It is quite safe to drink and should be used in drinking water where the supply is unknown or doubtful, and when it cannot be boiled.

Our custom of *washing the hands* before eating is excellent. When more than one person uses the same tray for taking food there is a great danger of spreading germs, unless hands are carefully cleansed.

In case of sickness we must not only look after the patient, but we must see that the disease is not spread to others. What, therefore, should we do? First, a *doctor* should be called and, if there is a good *hospital* near at

hand, the sick person should be carried there, where good nursing and medicines can be secured as well as doctor's care. The sick who are taken to the hospital have very much greater chance of recovery than if nursed at home. It is also safer for the family.

These diseases should be *reported* at once to the health officer. It is our duty to notify the authorities, so that precautions may be taken to *prevent an epidemic.* We should obey the health officer, and not leave the house if he orders us not to do so. *Quarantining* the family of those who have cholera is one way of stopping the spread of the infection. If we disobey and go out when we are quarantined, we may be the cause of many more deaths.

If we take proper precautions, there is no reason why we should not nurse the sick. Doctors and nurses do this and are not ill. It is cruel to neglect the sick because we are afraid of taking the disease. What shall we do, then, to *safeguard ourselves while nursing* a person with one of these diseases?

1. (*a*) All wastes from the body of the patient *must be disinfected.* Carbolic acid and lime may be used for this purpose. If you cannot get either of these, bury all waste matter at once. Vomit, urine and excreta should be well covered with earth, but it is much safer if *lime* can be covered over it first before the earth is added. Do not bury the waste near the water supply.

(*b*) The wastes from all members of the family should also be cared for in a sanitary fashion, for someone may have the germs without knowing it. Use carbolic acid or lime in the closet, or bury the waste as above.

2. Everything used for the sick person must be *kept separate* from the things used by the family. Their dishes, trays and cups should be washed separately and boiled in water to kill the germs. Their clothing and bedding, too, should be *washed* by themselves and *boiled.*

3. The house itself, as well as the sick room, should be well *sunned and aired*. Dryness and sunlight will destroy germs.

4. Wash your hands with warm water and soap, and use some disinfectant on your hands after waiting on the patient. *Always disinfect the hands* before eating.

5. All *drinking water should be boiled* and then cooled and kept covered. Pour the water out into a cup, instead of dipping into the water (chatti).

6. Keep *all food covered* from dust and flies. *Cook the food* before eating. Avoid raw fruits and salads. Do not use food that has been allowed to stand all night. Cholera germs grow in cooked rice that has been allowed to stand.

7. Do not allow visitors into the house. They may spread the disease to their own families.

8. If anyone is suspected of having the disease, keep him in a separate room for forty-eight hours. Anyone who has been exposed to infection should also be isolated for two days, until it is known whether he has caught the germs.

9. When the patient is recovered or removed from the room, it should be scoured with washing soda, and sprayed with disinfectant.

Children are very apt to suffer from *diarrhœa* and such intestinal complaints. Their little bodies cannot kill the germs. This is the chief reason so many babies die in India. It is a terrible waste of human life, and it can largely be *avoided by cleanliness and care*. Unclean food and water are the causes of infection. We will later talk about the proper kind of food for babies, but now we are chiefly concerned with them being clean and safe. All that has been said about the protection of adults, to safeguard them against intestinal diseases, is especially true for young children and babies.

1. All water must be boiled and cooled for the baby to drink.

2. The food must be kept away from flies and covered from dust.

3. No one should give a baby solid food. It cannot digest it.

4. Keep the baby covered and warm at night.

5. Put a netting over the cradle, to keep flies and mosquitoes off.

Intestinal worms. Three kinds of worms are apt to get into the intestines. These do not give you disease, but they weaken you, make you pale and thin and tired. They are like the germs in one respect, in that they get into the intestines with our food and water, and they are spread by the body wastes. The *hookworm* fastens upon the walls of the intestines and sucks your blood, weakening and causing *anæmia.*

The eggs of the hookworm pass out through the intestine, and in the soil the eggs soon hatch into tiny worms. When you run barefooted, these tiny worms get between the toes and work their way under the skin, then into the blood, and finally into the intestines. They cause sores where they burrow into the skin, and these sores are sometimes called *ground-itch.* The hookworm saps your energy and strength. This trouble can be prevented, as all other intestinal diseases can, by proper *sanitary care of the body wastes.* Be sure that you do your part in helping to keep things clean. I think now we ought to respect the work of the *sweeper* more than we have in the past. They, too, must realize the importance of their work. This is a special work which should be well paid, and the sweepers should be trained to carry out their responsibilities with the best methods and a feeling of the dignity of their calling. In the body we know the organs for the disposal of wastes are as important as any other organs, and the body would die if they neglected their functions. So, in society the sweepers have it in their hands

to keep us well or let us die, by neglecting to perform their work conscientiously. Let us remember our indebtedness to them.

AGENDA

Oral and Practical Work

1. What is included in the term 'alimentary tract'?
2. To what do you liken enzymes?
3. Why shouldn't we swallow our rice without chewing it?
4. Why are hard foods good for us?
5. What do you understand by peristalsis?
6. What is the function of the stomach and of the gastric juice?
7. How do you test an acid?
8. What is the test for protein?
9. Compare the structure of the small and large intestines?
10. What is the work of each intestine?
11. What is the function of the juices secreted by the pancreas?
12. What is the fluid secreted by the liver?
13. Why is it important to vacuate the rectum daily?
14. What foods will assist this process?
15. Why are diseases so easily acquired through the alimentary tract?
16. What practical lessons does this teach us as to care of food?
17. How are these diseases spread in the bazaar?
18. What danger is there from body wastes?
19. How should they be disposed of?
20. Why is pure water so important?
21. How would you clean muddy water?
22. How can you make water and milk safe for use?
23. What is meant by quarantine?
24. By what means can healthy people be safeguarded while nursing the sick?
25. What is the cause of diarrhœa, and how can it be prevented?
26. How do worms gain access to the body? How can we avoid them?

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CHAPTER VIII

CARE OF INFANTS AND YOUNG CHILDREN

'God lent His creatures light and air,
And waters open to the sky,
Man locks him in a stifling lair,
And wonders why his brothers die.'
—*Dr. Oliver Wendell Holmes.*

Required.—Basket for cradle, mosquito netting, bedding, large baby dolls, infants' and young children's clothing, safety pins, rubber cloth.

EVERY girl looks forward to the time when she may have children of her own, and most girls help their mothers in caring for little brothers or sisters, or for little nephews and nieces—even sometimes from infancy. It is, therefore, necessary for you to learn something about the right way in which to bring up little ones who may at some time be entrusted to you.

Every baby needs ample sleep and rest, fresh air, regular bathing, regular feeding and safe water, prompt attention in sickness, muscular exercise, suitable clothing and proper mothering, and training in good ways.

Sleep and rest. A baby needs abundance of sleep. A newly-born baby normally sleeps nine-tenths of its time. At six months it should sleep two-thirds of the time. If it is sleepless, it is uncomfortable, due most probably to its being irregularly or too often fed, overfed or hungry, wet or cold, or oppressed by excess of bedclothing and overheating, or the nursery may be insufficiently ventilated, or baby may be suffering from thirst or irritation of the skin.

How to make the bed for a baby. A basket makes an excellent bed for baby, but a cradle will do, provided it is not rocked. Place a mattress in the bottom and over this a 'chaff'-filled pillow. This latter can easily be washed or changed if it is soiled. Lay a piece of rubber cloth over the chaff pad and cover it with a double fold of clean old chaddar. Chaff makes a good filling for the tiny head pillow also. In hot weather baby can lie on this dressed only with a napkin. At night he will require more covering, and the bed can be prepared more or less after the following fashion :—

1. Place a clean woollen blanket over the basket or cradle, and on this lay the mattress.
2. Over this place the 'chaff' pillow.
3. Lay a piece of rubber cloth over the chaff pad.
4. Cover this with a piece of old blanket, and lay the tiny chaff pillow in place.
5. Cover baby with a loose, fluffy shawl.
6. Fold the blankets over the sides and turn up the foot and secure it with safety pins. This should not be too tightly fastened, but allow room for baby to kick and move.

The amount of covering required depends upon the season and climate. Hot water bottles may be put between mattress and chaff pad, if the weather is cold. The baby should not sleep in the same bed with his mother; it is both unhealthy and risky, as baby may be overlaid.

Where should the cradle or basket be placed for baby? Not at the side of the mother's bed, but at the side of the window. Place a screen to prevent a draught, but permit the window to be open and fresh air to circulate all night (Fig. 109). If the baby is well tucked in and his bedding pinned, he can sleep in a cold room and be all the better for it. He should sleep in a sheltered verandah in the daytime, but protected from the sun.

As you already know, diarrhœa and similar diseases are spread by flies, and malaria is given by mosquitoes. These insects flying round also prevent the baby from sleeping and make him irritable. Therefore, he must be protected from these enemies of his health by a piece of mosquito netting fastened carefully over his cradle or bed. The ideal thing is to screen the room itself, but, whether you can do this or not, everyone can have the small piece of netting required for the baby.

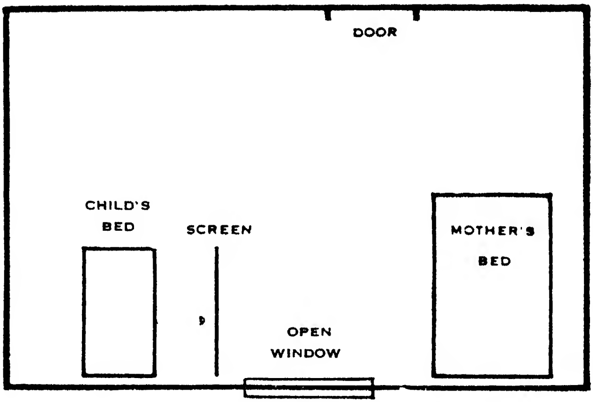

Fig. 109.—Proper placing of baby's bed

Bathing. A warm sponge bath should be given *every day*, either in a small tub or in the customary way of laying the baby on the mother's legs and pouring warm water over him.

The nose and mouth should be kept clean, but *gentleness* must mark all such care. If the eyes show a discharge and the lids are swollen, call the doctor at once. Any soreness or redness of skin should be treated with oil, but do *not* use powders. *Sunlight* and *fresh air* are the best treatment for babies' skin, together with *perfect cleanliness*.

In the excessive heat he can be made more comfortable by giving him a sponge bath two or three times a day. Do not let him get chilled, but keep him in a cool, well-ventilated room. He should have his airing in the early morning and evening.

An even temperature. A baby feels the heat more than we do. Therefore we should try to keep him cool without letting him be in a draught. Keep him quiet, for the heat makes anyone irritable, and a baby needs to be let lie quietly rather than to be held in the lap and played with. If he has a *heat rash,* in spite of your precautions, try placing him in a bath to which has been added a tola of bicarbonate of soda.

Feeding. After the bath the baby may be fed. The feeding may be repeated every four hours. Every four hours, alternating with the feeding, let the baby have a little *water* which has been boiled and cooled. Do not give the baby *any* food such as sugar.

After the baby has finished nursing, hold him up against your shoulder and pat him gently on the back to bring up any air he may have on his stomach.

Nursing the baby is the normal method, but it must be done in the right way. The rules for this are (1) *regularity*, (2) *longer periods between nursing*, (3) *shorter nursing periods* than usually followed. A baby is the easiest thing in the world to mould into *good habits.* But the bad habits are just as easy to form. So we must begin right away to train the child to the habits which will make it a pleasure and a delight to parents and friends.

Sometimes the baby does not have sufficient food to make it grow as it should. Then the mother's milk should be supplemented by giving the baby extra milk (modified according to the plan that will be explained later in Chapter XIII) after each nursing period.

You can tell whether the baby is getting sufficient food

by weighing it *before and after feeding*. Try several times and see whether it gains three or four ounces at each feeding, as it should.

If the body is not supplied with the right food, its organs cannot properly function, digestion is impaired, muscles become weak, bowels become constipated, sickness results, and the little child wastes away. Let every girl and woman, therefore, acquire the knowledge that will prevent this unnecessary suffering and loss of life. The principles are simple, far simpler and easier than the work of attempting to *cure* the child of the diseases which result from ignorance and neglect.

The following is a good schedule for baby's food:

Age of Baby	Interval Between Feedings	Number of Nursings in 24 Hours	Number of Nursings Between 10.30 P.M. and 6 A.M.
1st and 2nd days ...	4 hours	5	1 or 0
3rd day to 2 months	4 or 3 hours	5 or 6	1 or 0
2 months to 3 months...	4 or 3 hours	5 or 6	0
After 3 months ...	4 hours	5	0

The number of feedings depends upon the amount of milk the mother has and upon the size and strength of the baby. It is a mistake to feed too often, and if baby can be kept on a four-hour schedule so much the better. The stomach requires rest.

Regularity of feeding, sleeping, bathing, bowel movement, outing, etc., are all important. Regularity in habits of eating and sleeping should be established during the first week of life. Night-nursing is a bad habit for a baby, and after the baby is two months old, if not from the first, there should be *no* feeding between the hours of 10 p.m. and 6 a.m.

Weighing the baby as soon as it is born, and thereafter

once or twice a week, is the surest way of knowing whether the infant is growing as it should. A baby should gain about six ounces a week during the first five months, and four ounces a week during the next three or four months. If, therefore, your baby weighs six pounds at birth, it would double its weight in five or six months, and would then weigh twelve pounds (seers). When nine months old, it would weigh sixteen pounds. If a baby does not grow in this way, you should get the doctor's advice about the food. Another way of knowing whether the food is agreeing with the baby is the way it behaves. If the baby sleeps well and seems happy and comfortable, digesting its food and having regular bowel movements and plenty of urine (water), you may rest assured that the nursing is successful.

The *bladder and intestines* begin to be active soon after birth. No medicine is required unless the baby is badly constipated or jaundiced, when castor oil is given in a *small* dose. The natural colour of the movement is first black, and it will be several days before the movement becomes yellow. The normal appearance of the bowel movement, after the first few days, is yellow-orange colour, and a consistency like butter, with a slightly sour odour, but not unpleasant. There may be from one to four movements a day. If the baby's movements of bowels become too frequent, are watery, or otherwise abnormal, you should see a doctor, for this is a sign that something is wrong. You would be wise to reduce the food and give him cool water, that has been boiled, to drink. An enema with a little salt in it is a good thing to give also. All that has been said about *cleanliness*, *coolness* and *quiet* should be carefully followed. If the baby vomits and is feverish, stop all food until the doctor comes. The character of the *stools* is the best guide a mother can have as to the condition of the baby. They may be likened to a thermometer in registering the digestion and assimilation of the infant's food.

Care in sickness: abnormal motions

1. *Green motions.* Greenness is commonly a sign that the bowel contents are being hurried on too quickly, due to some disturbance.

The disturbing factor may be, on the one hand, a mild passing chill, a nervous disturbance or a slight disagreement of food; or, on the other hand, the greenness may be the first sign that hostile microbes have invaded the bowel in force, and the baby is threatened with an attack of grave diarrhœa. If in doubt, give a dose of castor oil and allow nothing but boiled water for a few meals; don't feed and encourage the microbes. An occasional green motion is consistent with health; indeed, a baby will sometimes have one or two green motions every day for a week or more, without appearing to be upset, but when motions are green the mother should always be on guard. The worst motions of this class are grass-green when passed, or look like chopped spinach. The sign that improvement is taking place is the gradual appearance of more and more of the yellow element among the green.

Motions which become green only after they have been passed for some time are usually of less significance. Taking too much whey may cause bluey-green relaxed motions. If a baby is given grey powder or calomel, the mercury tends to cause the motion to be greenish.

2. *White, tough, pasty, bulky motions* are apt to occur where babies are fed on unmodified or merely diluted cow's milk, owing to excess of indigestible curd.

3. *Curd in the motions.* The significance of particles or lumps of curd in the motions is due to too much protein; therefore the milk should be further diluted.

4. *Pale, clay-like motions* may be due to deficiency of bile, arising from obstructed bile duct or disordered liver.

5. *Brown, black or red motions,* caused by bleeding in

the stomach or bowels, according to site of hæmorrhage. Get the doctor *at once*.

Black motions are normal in the first week of life and may also be caused by drugs. Brownish motions are a normal result of starch or starchy patent foods.

6. *Thin, watery stools* are common in diarrhœa, but are most marked in rare choleraic summer diarrhœa, tending to rapid collapse.

7. *Frothiness and foulness of motions.* Much slime and mucus is specially seen in disorders of the lower parts of the bowel, and may be the herald of acute dysenteric diarrhœa, leading to blood and pus in the motions, followed by rapid poisoning of the system, torpor and collapse. Much jelly-like mucus, associated with the presence of worms, may be present as a chronic condition in weakly, dyspeptic children.

It is natural for the baby to *cry*, to express his wants and feelings. A mother comes to recognize the various cries of her baby, so that she can tell whether he is hungry or in pain.

Colic is the term applied to severe pain in the stomach. The symptoms are crying, distended abdomen and cold feet which he draws up tight. It is important to get him warm. Fill a bottle with warm water, cover with a cloth and lay at his feet. Give him some warm water in which a little bicarbonate of soda has been dissolved (½ tablespoon to 1 pint; or 1 massa to ½ seer). Rub his abdomen with oil, and place flannel cloth, wrung out of hot water, on his abdomen. Be careful not to burn or scald the tender skin. Cover him and keep him warm. Probably the colic is caused by indigestion or constipation, and an enema should be given, consisting of 1 cupful (½ seer) of warm water (110° F.), containing ½ teaspoonful or 1 massa of purified table salt. This is introduced into his rectum by means of a small rubber tube. (A rubber ear syringe can be used.) Regular habits in emptying the bowels should be established as soon as

possible. Sometimes 15 drops of cod liver oil, if given two or three times a day, or even sesame oil, will correct the tendency to constipation. Massaging the abdomen from right side to left side across, and down the left side, in a circular motion, is the best way to start peristalsis and stimulate a movement of the bowels.

One thing in particular you must be warned *against*, and that is, giving patent medicines, soothing syrups and opium. If the baby is in pain, we must find the cause and remove it. Perhaps he is being fed too often, or too much? Try reducing the length of time he nurses, and lengthening the time between feedings.

The nursing mother will not only wish to cure colic, but also to prevent it. The chief causes are: (1) milk of the wrong composition, which may be due to the mother's health, or to unsuitable artificial food. The nursing mother sometimes prevents baby's colic by giving a few teaspoonfuls of boiled warm water before suckling. She should regulate her own diet and take proper exercise, to make her milk normal; (2) overfeeding which can be determined by the condition of the baby's bowel motions; (3) irregular or too frequent feeding of the baby. If this is the cause, wait an extra half-hour between feedings. Perhaps food is taken too rapidly or too slowly; if artificially fed, the hole in the teat may be too large, or if too small the milk may get cold before he has finished suckling; (4) constipation or diarrhœa of mother or child; (5) chilling the baby's body due to slowness in bathing, wrongly prepared bed, wet napkins, cold feet, etc.; (6) insufficient exercise and free activity of limb and body; (7) irritation of the skin due to wrong clothing.

Convulsions. Convulsions are both dangerous to life and damaging to the nervous system. The chief point is to develop a strong constitution that will prevent convulsions. Regularity of the bowels is a matter of first importance.

The attack may be preceded by indigestion, colic, teething, etc. The symptoms of convulsions are squinting, rolling eyeballs, twitching fingers and the thumbs jerking into the palm of the hands, stiffening of the neck, throwing back the head and jerking the limbs, and so forth. The mother should act quickly to prevent a fit. First, give a warm salt enema, and apply cloths rung out of hot water to the abdomen, being careful not to burn. Give a teaspoonful of castor oil. This may prevent the attack. Second, give a warm mustard bath by putting one level dessertspoonful of mustard into each gallon of water. Make the water about blood heat. Let the mother test the water by putting her elbow into it to see whether it is a comfortable temperature. The child may remain in the bath from two to ten minutes, and a cloth rung out of cold water may be applied to the head. She should not let it become chilled after the warm bath, but wrap quickly in a large warm towel and put on warm night-dress and into a warm bed, without delay. Third, if the mother knows that her child has had any indigestible food she should induce vomiting by giving half a teaspoonful of ipecacuanha in warm water every quarter of an hour, until vomiting begins, but never give more than four doses. If she has no ipecacuanha, one teaspoonful of mustard in warm water may induce vomiting.

As each case differs, one can never give just the same treatment to all children, and a doctor should be called without delay.

Croup. Croup sounds alarming, but may not be dangerous. Sometimes the hoarseness and barking cough may be symptoms of diphtheria, or other throat trouble; therefore a doctor should be consulted. If it is only croup the mother can very well treat the child herself.

The child usually awakens suddenly at night and is scarcely able to breathe. He coughs with a loud and brassy cough.

Treat much as you would for convulsions. Sometimes

breathing the steam from a jug of hot water will help to loosen the cough, but care must be taken not to burn him. Warm the room, keep him out of a draught, but allow plenty of fresh air. It is better to prevent croup by following the health rules.

Eczema. Eczema is the commonest skin disease in babies. It begins with redness and roughness, then the skin becomes watery and scabs form. It is intensely irritable and the child must be prevented from scratching, as this will make it impossible for the skin to heal.

Eczema is the result of breathing and living in impure air, poor digestion due to wrong food and lack of exercise. Overfeeding, milk and constipation are frequently at fault, and it is usually the fat, over-fed baby who suffers from this trouble. Too much clothing, and imperfect drying after the bath, soiled napkins, scratching or chafing of the clothes, retard recovery.

In order to cure eczema, you must observe all the general rules of hygiene. Stop washing the skin with soap, though clear water may be used. Dab the skin instead with olive or sweet oil, but do not rub. Tie the child's hands in little bags, to prevent them scratching. Soak off scabs with sweet oil, to stop the irritation. A simple ointment, such as freshly boiled ghee, spread on mulmul, can be applied to the sore part. This should be changed twice a day, using oil to remove the bandage if it tends to stick. A good ointment can be made by using one ounce of white vaseline, one drachm zinc ointment, one drachm olive oil and half drachm lanolin. If, however, the doctor can be seen, it is wise to get his advice, as the cause of eczema may be some microbe which requires special medical treatment.

Teething. There need be no terrors for the mother of a teething infant if she has observed the rules of health. The secret during this time is avoidance of chill and keeping the bowels open. Let him have plenty of water, ripe clean

fresh fruit juice and, if old enough, light food including milk, and there should be little occasion for worry.

The *milk-teeth* normally begin to appear between the seventh and twelfth month, and by the end of the second year a set of twenty should have come through the gums.

The teeth come in groups, thus allowing intervals of rest. During these early years of childhood the bones are easily moulded, as we have seen in Chapter IV. The practice of using a dummy or pacifier is, therefore, to be condemned. These rubber teats, fastened to a cord, are supposed to provide enjoyment for the child and keep him quiet. Sucking such a dummy, however, is highly injurious, as the bones of mouth and nose are thereby contracted, the arch is deformed and proper teething interfered with. The teeth come in irregularly and out of place; mouth breathing is induced, and adenoids, enlarged tonsils, etc., are likely to follow. More than this, the dummy is wet with saliva from sucking and is frequently dropped on the floor; flies light on it and germs are thus carried to the mouth. It is a filthy, unhealthy and ugly practice, and should *never* be permitted.

Exercise. Exercise is important for an infant as well as for older children and adults. His nervous and muscular system demand this. A baby should be allowed opportunity for kicking and waving his arms, unhampered by clothing, for five or ten minutes at least twice a day. A pen can be arranged, with a soft quilt on the floor, where with safety he can later crawl and play, rolling and tumbling without harm to himself. In this way, too, he will gradually learn to pull himself up, to stand and to walk. Supply harmless playthings for him, and later give him blocks of wood with which to build. Montessori materials, if they can be afforded, are an excellent means for early education in nervous and muscular control, as well as for mental growth.

Cleanliness in regard to food is the most important factor

Fig. 110. Clothing for infants

A, flannel-band; B, vest; C, napkin; D, drawers; E, pinning blanket; F, night-gown; G, zabla; H, slip; I, zabla; J, sun bonnet

in *keeping baby well.* Germs thrive in the warm weather, and it is necessary to take special precautions against their getting into the food. The breast-fed baby is not in so much danger from *summer complaints*, such as diarrhœa, as the baby which must be fed artificially; nevertheless cleanliness must be our watchword in everything which concerns the baby.

Flies are one of the most dangerous means of infection, and they must be kept away from the baby. They crawl over all kinds of filth, and then on to the food or the baby. This is one of the chief ways of contracting dysentery and diarrhœa. It is a matter of cleanliness of the food, clothing, body and dwelling, and care is essential if we wish to keep the baby well.

Clothing. In planning an outfit for an infant, it should be remembered that loose garments are more suitable than tight ones, both because of the climate and owing to the rapid growth of children from birth to two years of age. It should also be remembered that our aim is to preserve an *even* temperature over the entire body, as an essential of health.

The only tight binding permitted is during the first two weeks, when a flannel-band, 6 inches wide and 27 inches long, is wrapped tightly about the abdomen, to secure the dressings and keep the body warm (Fig. 110 A).

A loose band or vest, ganji-frock (Fig. 110 B), may be worn, like a little under-shirt, to protect the chest and abdomen from chill. If this has a tab on the lower edge, front and back, the diaper may be pinned to it for support.

Diapers are best made oblong, 36 inches long and 18 inches wide. These can be doubled to form a square, and again folded once or twice to form a triangle. This is wrapped about the hips and between the limbs to form drawers (Fig. 110 C). The several thicknesses of it are advantageous in keeping the body warm and preventing moisture from penetrating and spoiling the outer clothing. Many babies

and little children are permitted to go out without sufficient covering over the vital parts of the body. This exposure is dangerous, as infection from dust and dirt on floors and grounds may result in skin diseases, or even worse.

Care must be taken not to bunch the napkin too much between the legs, or the bones of legs and pelvis will be deformed. Napkins should be changed at once when soiled, placed in a tin of cold water, washed out and dried in the sun. Do not dry a wet napkin and use it again without washing it. Extra padding may be placed in the napkin to absorb the urine at night (Fig. 111). This should be clean, soft absorbent material and placed as illustrated.

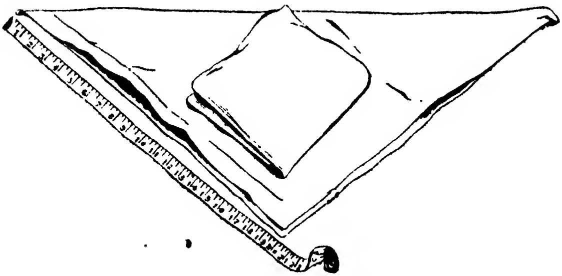

Fig. 111. Napkin and pad

When the child has been trained in proper habits, the diaper may be abandoned and *drawers* may be substituted (Fig. 110 D). Drawers should never be tight in either waist or stride. In cutting drawers make the curve shallow, in order that the leg length may be short in comparison to its width, and thus avoid any restriction in walking or sitting (see illustration).

One of the defects in the outfits of an Indian child is that the garments are too tight about the waist. In this case there is hindrance to free circulation of the blood. Clothing should, therefore, hang from the shoulder, in order that the tightness about the waist may be avoided.

A slip, or loose frock (Fig. 110 H), reaching down to the feet, should be worn over shirt and diaper. This may be cut out after a simple pattern, and sufficiently large to allow for the baby's growth. The neck of the slip may be made to fit by inserting a tiny tape which will draw up according to the size of the baby's neck. The sleeves can be also tied at first, while the infant is small. Made of good white mulmul, or lawn, it is easily constructed, easily cleansed and will last at least for a year.

The gaudy frocks, displayed in the bazaar, are much too small for comfort, and of such poor material that they will not wear well. The tinsel and lace quickly tarnish and tear, and the colour fades. This fading on the moist skin is a real danger to the health of the child, by poisoning with the cheap dyes used. Simple, white, washable, loose frocks are to be recommended. The child should be protected from chill due to changes of temperature, night and morning, by a light flannel jacket.

Booties or short stockings may be used to keep the baby's feet warm during the chill hours of morning and evening, to protect it from extreme cold and changes of temperature.

A pinning-blanket, or under-petticoat (Fig. 110 E), is another means of keeping the limbs warm in cold weather. Take a piece of woollen cloth, 25 inches long and 28 inches broad. Attach it to a band of white cotton cloth, 28 inches long and 5½ inches broad. Pin the band around the abdomen and fold the long skirt around the baby's limbs, and then turn up the ends like an envelope and pin with safety pin. This is better than a shawl, as it cannot slip or be kicked off.

A long wrapper of warm cloth may be worn over the slip or loose frock, to prevent the baby from chill in moist or cool weather, and this can be easily removed when the day grows hot.

When the climate is damp and cold, a cap is advisable,

The head covering, if any is used, should be cool, light and porous. The heads and eyes of little babies ought to be shaded from strong, direct sunlight; and when the weather is hot and dry a shade should be used to protect the child's eyes. A bonnet for this purpose may be made with a stiff brim, having a soft comfortable top (Fig. 110 J).

All garments worn by day should be changed before putting a child to sleep at night. A loose slip, or night-gown, is excellent; made with a draw-string through the hem at the bottom, the feet can be tied in like a bag and protected from cold at night (Fig. 110 F).

The following garments are suitable for little boys and girls:

1. A bodice (made of white flannel) or a knitted vest is quite necessary in the cold season for children, to be worn inside the polka or sadra and should be washed daily.

2. A pair of drawers (Fig. 110 G and J).

3. A zabla, combination of shirt and knicker or of shirt and skirt, may be made of any appropriate material if of fast colour. It obviates the necessity of separate bodice and knicker, or bodice and skirt, and only the drawers, vest in winter, or mulmul shirt in summer, need be worn under. A zabla is more suitable and hygienic for girls, as the weight of the skirt is then hung from the shoulder, and the waist is not bound by a draw-string. The latter is a hindrance to the circulation and causes her pain at the waist, and girls often suffer from so-called ringworm or skin disease in consequence. If a separate skirt is worn it should be attached to a broad band buttoned on to the bodice, or suspended by other bands over the shoulder.

Home-made stockings of warm cloth, or woollen-knitted stockings are sometimes useful to protect the child from cold in the winter, but ordinarily are not required.

A Dakṣhini or Punjabi shoe, or chapal, is more suitable than European boots which look awkward with the Indian

dress. Some foot protection out of doors is almost a necessity, if the feet are to be protected from hookworm when the child plays in a dirty or dusty street or in a compound.

A straight cap offers no protection from the sun's rays, and so a brim to the cap or a visor would be better.

Child training. The care and *management of children*, their health and training, are the responsibilities of every mother and require endless patience, love, kindness, firmness, tact and self-control. Her vision of what she wishes her children to become in character and conduct must be her guide. She must realize that the feelings, thoughts and behaviour which she wishes them to display can best be taught by example. She must be what she wishes them to become and possess high ideals if she wishes them to do so. The teaching in the early childhood of the *Bhagavad Gita*, *Koran* or *Bible* stories, interpreted by a wise mother, make a lasting impression upon youth. Mental suggestions are powerful, and we can thus plant the seeds of the great virtues—self-control, kindness, courage, ambition, love, pity, loyalty and truth.

Children should be put to bed regularly at a reasonable hour. It is well to continue the morning sleep or rest until the child is five or six years old, especially during the summer, when children wake early. This can easily be accomplished if there is a little firmness on the mother's part. A short sleep or rest restores a child wonderfully, and the result is that there is no crossness or fatigue at the end of the day.

The mother, by good home management, will train her children in the *social habits* of promptness, orderliness and system. She should give each child household duties for which he or she is responsible and made to attend regularly. Only thus can responsibility be acquired. The care of pets, which necessitates regular feeding, is an excellent duty for

any child interested in animals; in this way kindness, too, is strengthened. The parent must be ever watchful to avoid neglect of the duties which may cause injury to the pet.

It is wise to give children an *allowance* of money and to make them responsible for buying certain things they require. Let them learn to keep account of their expenditure and, if possible, begin a post office savings account.

The question of *punishment* is always a difficult one; for love and kindness must be tempered with justice and firmness. Let it be understood that no punishment which causes fear and loss of self-respect is ever going to do any good. It will only cause lying and deceitfulness. Our purpose is to develop character and, therefore, we must try to understand the children and help them to see the difference between right and wrong. Never punish when either you or they are angry, and corporal punishment should rarely, if ever, be used.

Much of children's naughtiness is the result of thoughtlessness and the spirit of youth. Parents often fail to understand their children. They do not give attention to inquiries and requests which to the little child seem of great importance, though to an adult they are trivial. Listen patiently to their questions and answer your children reasonably if you wish to establish confidence and mutual respect. It is far better to teach them that they are good and that they possess the virtues of kindness, patience, courage and truth. Expect them to be good and ignore the small faults which are of little consequence. Patience is required to train their good manners; but neither fear nor bribery should be used to compel obedience. *Rewards and prizes* are almost as bad as fear and punishments. Let the parents seek rather to inspire right conduct from motives of love and kindness. Children are all different and require individual teaching, as every wise mother knows. Whatever may be their form of religion, all parents should impart to

their children the sense of the love of God as the guiding spirit of their lives. That knowledge of eternal love will result in family love and goodwill towards all.

The power of suggestion is practised by Hindu mothers, who teach the *Gita* to their children, at night, by the bedside, interpreting the words of Shree Krishna, 'Who sees God in other beings, treating them as he treats himself, that man God loves.' The mother sees her son as Arjuna who must fight the battle within himself, overcoming human problems, by the use of his five senses, with the power and insight of his soul.

Life is a battle indeed, and the destiny of the race lies in the hands of its mothers.

AGENDA

Oral and Practical Work

1. Name ten things which every baby requires for healthful growth?
2. How would you plan baby's day so that sleep, food and bath would be given at proper intervals?
3. How will you prepare baby's bed?
4. Why should he have a netting over his cradle?
5. What are the rules for nursing a baby properly?
6. How can you tell whether the food is agreeing with baby, and he is growing properly?
7. What is the best way to dress an infant?
8. How should older children be clothed? Plan an ideal outfit.
9. What should be done in case of colic? How can it be prevented?
10. What causes convulsions? How would you act under such an emergency?
11. What is croup? How treat a croupy baby?
12. What causes eczema? How cure and prevent it?
13. What care does baby require when teething?
14. Why is a dummy bad for baby?
15. How would you train a child to know right from wrong?
16. How may right habits be formed?
17. How teach responsibility?
18. Why is bribing a child with some reward an unwise way of securing obedience?

Exercise 5. (1) If possible have a doll and small basket-cradle, and let the girls practise making it for baby in hot and cold weather.

(2) If the doll is of celluloid, it can be washed. In any case go through the motions of bathing the baby and putting it to sleep.

(3) In the sewing class, bedding and clothing for the baby doll can be made for this class.

It is even better to let the girls make clothes for some small child in their own family or for the poor.

N.B.—If you can, visit the babies' ward of a hospital.

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CHAPTER IX

GENERAL HOME NURSING

'When pain and sickness wring the brow
A ministering angel thou.'

Required.—Bed and fittings, towels, clinical thermometer, watch with a second hand, gauze, cotton wool, flax seed, mustard, small labelled bottles or jars of alcohol, zinc ointment, turpentine, eucalyptus oil, carron oil, camphorated oil, castor oil, vaseline, permanganate of potash, tincture of iodine, Epsom-salt, ipecacuanha, boric acid powder, bicarbonate of soda, quinine, calomel, ammonia, aspirin, oiled silk, graduated medicine glass and spoon.

We have learned in the preceding chapters what causes disease and how to prevent sickness, as well as the method of meeting some emergencies which may arise. We have seen what care is necessary for the young infant. Let us now consider briefly the preparation which must be made in a home to care for invalids generally and what we can do to increase our patients' chances of recovery.

The room. Choose a room which is cheerful in aspect, but isolated more or less from the rest of the house. This is for two reasons: in order to *provide quiet* for the patient and also to lessen the danger to others of *infection.* You can readily understand the importance of both these needs. In time of illness one's nerves are especially sensitive and noise is very irritating. The patient should sleep as much as possible and, therefore, quiet is of the utmost importance.

The danger to others from infectious diseases, such as mumps, scarlet fever, diphtheria, smallpox, cholera and consumption, is very real and isolation is imperative.

Air. The room should be large and have two windows

for cross ventilation (see p. 33, Part I), but draughts must be avoided. A good supply of fresh air is a great help to recovery, as you should now well understand.

Light. Sunlight, you know, is a great germicide and aids in the cure of disease. It is also active in developing vitamin D which, we will later learn, is essential to health. Therefore do not shut the sunlight out all of the time, even though it is necessary to do so in the middle of the day. The patient's eyes should, of course, be screened from the glare.

Temperature. The room should be kept at as even a temperature as possible. Methods of heating and cooling have been discussed in Part I. If the floor is of stone, cold water may be poured over the floor to lower the temperature and khas-khas tatties hung at the openings. In a cold climate it is wise to select a room with a fireplace and chimney. This provides for ventilation as well as warmth.

Furnishings. Remove all unnecessary furniture and ornaments from the sick room. Pictures become tiresome to an invalid and extra furniture requires extra cleaning. A bare floor, with only a bedside mat, is best. A bedside table is useful for holding small things like a glass of water and a vase of flowers. Medicines should not be kept there, but on a shelf in a cupboard out of sight of the patient. A comfortable chair for the nurse completes all the required furniture except the bed.

Care of the room. Avoid raising a dust when sweeping, or, better still, wipe the floor with a mop. Dust with a moistened cloth. Remove soiled things from the room immediately.

The bed. A metal bed is cleanest. The mattress should be firm though soft and should be protected by a covering which may be changed. Place the bed with the head beside the window, not standing in the corner, nor facing the light from window or door. This provides for good ventilation,

prevents eye strain and permits the nurse to reach her patient from both sides of the bed.

Making the bed. Lay a square of rubber cloth about half-way down the bed, and over this draw a sheet that has first been folded lengthwise. This is called a draw sheet, and it should be tucked in well on one side and then drawn very tight and tucked under on the opposite side. This sheet can be changed more easily than the large sheet in case the bed requires it; it is also easy to tighten if the sheet becomes wrinkled. Place the top sheet on and tuck it first well in at the foot of the bed, leaving enough of the sheet at the head to turn back over the blankets and counterpane. The sides are not tucked in all the way to the head, for you must leave an opening for the patient. A mosquito net should be hung over the bed, to protect the patient from mosquitoes and flies.

Exercise 6. First practise making an empty bed. Have everything ready before beginning. Sheets should be well aired and dried. Over the mattress place a piece of cotton dhurrie or blanket. See that it lies smooth. Put the bottom sheet on, tuck in both ends and one side well; then draw the other side *tight* and tuck it far under so that there may be *no wrinkles*.

Changing sheets, with a patient in bed, is fairly easy if she can be turned. Put her on her side with her back towards you. Remove all covers but the top sheet in summer, or enough covering to keep the patient from being chilled. Loosen the soiled bottom sheet from under the mattress, on the side from which you are working. Gather it into loose long folds, and push it well up against the patient's back. Take the fresh sheet, which has been previously gathered into smooth folds, leaving just enough unfolded to tuck in under the edge of the mattress. Lay this on the bed and tuck in the unfolded part the full length of the bed. Push the folds of the clean sheet close against the back of the patient and turn her over towards you, with

her face to the side of the bed which has been covered with the clean sheet. Go to the other side of the bed and draw out the soiled sheet, removing it from the bed. Draw the clean sheet over from behind the patient, smooth and stretch it and tuck it under the mattress edge. Change the draw sheet and rubber in the same way.

Lifting and moving a patient in bed can be best done by standing on the *right* side of the bed. Let her put her arms around your neck. Then put your *left* arm around and under her shoulder, leaving your right arm free to adjust the pillow or do anything necessary. To move her to the side of the bed, put your arms under her shoulder and hips and so *draw* her *to* you.

Changing the nightdress is more easily accomplished if it is split down the back. This is also more comfortable for the patient. If it has not been split, the method of *removing* the gown is as follows. Draw the gown well up under the arms (working under a sheet). Draw one sleeve off and lift the gown over the patient's head; and then slip off the second sleeve. Reverse the order for *putting* on the fresh one. Put one sleeve on, put the gown over the patient's head, put the other sleeve on and pull the gown down under the patient, leaving no wrinkles.

Bed sores are the result of pressure and unclean, damp or wrinkled bedding. Good nursing should *prevent* them. If the limbs, back, and shoulders are rubbed with alcohol to keep up the circulation and the bed kept in proper condition, there should be no sores to reproach the nurse. Zinc ointment helps to heal sores, if they do form and the skin is broken.

Bathing a patient in bed. This should be done either before breakfast or an hour or more after. Have everything in readiness before beginning: sheets sunned, nightgown aired, towels, wash cloths, soap, alcohol, jar for waste water, large basin or brass vessel on a chair or stool, hot and cold water. Put a blanket under the patient in the

same way you did the sheet; place another over her and remove the nightgown or sari.

Begin by bathing the face and ears and continue in this order: face, ears, neck, arms, chest and abdomen, feet and legs. Then turn her on her side and wash the back, dry it and rub her back, shoulders and hips with alcohol. Let her lie on her back and wash the pubic region.

In bathing each part place a towel under it so that the blanket will not be wetted; dry the part before beginning on another. Change the water after bathing the trunk and again after bathing the legs and feet. Hands and feet may be placed in the basin to wash. Wipe thoroughly, so that no bed sores will form. The teeth must be brushed, hair combed and nails cleaned.

Keeping records. The temperature should be taken night and morning and recorded on a chart. Also record the pulse, respiration, amount of sleep, amount of food taken, the excretions, their number and description.

Time	Temperature	Pulse	Respiration	Sleep	Medicine	Bowels	Urine, amt. passed	Food: Quantity and Kind
a.m.								
1								
2								
etc.								

The doctor can determine the nature and progress of disease by watching the rate of heart beat or pulse, the respiration and body temperature. Therefore the nurse should be expert in taking and recording this information. You have already learned about this in previous chapters.

Temperature is taken with a clinical thermometer. Wash it in clear, cold water and shake the mercury down with a quick jerk. The temperature may be taken in the *mouth*, by placing the mercury end of the thermometer under the tongue and closing the lips. One minute is the usual length of time required, but thermometers differ—some requiring longer to record the temperature. A baby's

temperature is usually taken under the arm, or in the rectum. The temperature recorded under the arm is one half degree lower and in the rectum one half degree higher than in the mouth.

The *normal* temperature is 98·4° F. If it is lower than this we call it *sub-normal* and at 96·5° F. it indicates *collapse*. What would you do if this occurred? Temperatures above normal indicate fever which is usually lower in the morning and higher at night. Moderate fever is indicated at about 100° in the morning and from 102° to 103° at night. High fever will register 102° to 104° in the morning, and 104° to 105° at night. This temperature is dangerous if long continued. Do you remember what to do to reduce the temperature? Cold sponge bath and cold compresses can be applied, or rub the back with alcohol and call the doctor.

Fevers end either slowly, as in typhoid fever, or suddenly by *crises*, as in pneumonia. When a sudden drop in temperature occurs, apply *hot* applications and give hot tea or medicine, to prevent heart failure. You have already learned how to count the pulse and that the normal pulse of a man is 60 to 70 beats per minute, of a woman it is from 65 to 80 beats and of a child from 90 to 100 beats. The pulse varies according to age, activity and position. *Respiration* is normally 18 to 24 breaths per minute. Try to count it when the patient is unaware of your doing so. Sometimes you can continue holding the pulse and pretend to be counting it, while in reality you are watching the chest rise and fall.

Doctors' orders should always be carried out absolutely. Ask questions and be sure the orders are understood. *Regularity* is important in giving both food and medicine. Delay may cause serious trouble. Make your preparations in time, so that you will be ready to give the nourishment or medicine at the exact hour.

Food for the patient should be served daintily, with clean linen and dishes so as to tempt the appetite. Take care to have hot things really hot and cold foods cold. Do not serve large quantities, but give the right amount the patient is permitted to have. Plan for variety in the diet, nicely seasoned. The discussion of food is to be found in later chapters.

Giving medicine. It is wise to ask the doctor to write down his exact orders, so that no mistake can be made as to *time*, *amount* and *sequence* in which the medicines or treatments are to be given. All medicines should be locked up so that no one but the nurse can get them. Poisons and strong medicines should be kept separate from others and poisons should be *marked unmistakably* with a coloured label; put them on the top shelf. Never give nor take medicine in the dark. Never use an unlabelled medicine, either liquid or powder. Look at the label *three* times: first, when you take the bottle from the shelf; second, when you pour it out; third, when you return the bottle to the shelf—and in this way avoid giving the wrong medicine by mistake. Measure carefully and exactly the quantity ordered by the doctor; for this a measuring glass is best, because spoons differ in size and some people fill them fuller than others. Buy only the amount required and keep the bottle corked, for some medicines lose strength in standing. Give medicines at the hour ordered. Never take another person's prescription; and avoid patent medicines.

Medicine chest. A special cupboard with a lock is best and one too high for children to reach. This should contain the simple remedies which might commonly be needed in an emergency. It is not wise to keep medicines from old prescriptions, as they lose strength and would not be suitable for anyone but the case for which they were originally purchased. Everyone should keep a few bandages, absorbent cotton wool, a bottle containing sterile gauze or lint,

hot water bag, eye-wash glass, clinical thermometer, medicine glass, adhesive plaster; oiled silk, eucalyptus, vaseline, carron oil, camphorated oil, castor oil, permanganate of potash, tincture of iodine, boric acid powder, bicarbonate of soda, Epsom-salts, quinine, calomel, ammonia, aspirin, mustard and ipecacuanha.

Counter-irritants are used to draw the blood to the surface of the body. They may be hot or cold. A rubber bag or a bottle filled with hot water and wrapped in flannel to prevent burning may be used; a hot brick or flat iron, a bag filled with hot sand or hot salt, are all useful means of heating some special part of the body. Ice bags are made of rubber and can be partially filled with crushed ice and covered with a piece of cloth.

Stupes are cloths wrung out of very hot water. Sometimes the doctor will order turpentine mixed with a little oil to be added to the water. Use a cloth (preferably white flannel) three times the size of the area to be covered. In order to wring dry a cloth so hot that you cannot do it with your hands, lift the cloth with a wooden stick and lay it in the middle of a towel; then twist the ends of the towel in opposite directions. Unfold the flannel and place it on the patient as hot as it can be borne. Cover it with a piece of oiled muslin, a towel and a piece of dry flannel. Wring out another stupe and keep changing them for fifteen minutes or as long as the doctor advises. Be careful not to burn the patient.

Hot and cold compresses. Use clean bits of cloth, pieces of gauze or cotton wool and dip in hot or cold water. Apply them to inflamed parts, for fifteen minutes at a time, at intervals through the day. Sometimes hot and cold compresses are alternated. If they are applied to an infected part, like the eye, never use the same compress on the two eyes and take care not to touch your own eyes. Keep everything very clean.

Poultices are used much less than in former years, as they keep the tissues moist and warm and therefore encourage germ growth. In pneumonia they may be used on the abdomen. Usually we make them of *flax seed*, by adding flax seed meal to boiling hot water until the mixture is thick enough to drop from the spoon. After it is thoroughly heated, remove from the fire and beat it until light. Spread the mixture upon a clean piece of cloth which is enough larger than the poultice that the edges can be folded back. Do not make it too thick. Test the heat against your cheek before putting it on the patient, then cover it with oiled silk and a folded towel. Do not allow it to remain after it is cold, but replace with a fresh hot one.

Mustard plasters for adults are made by mixing one part of ground mustard with eight parts of *maida* or white flour. For children there should be twice as much flour used in proportion to the mustard. Spread on a cloth in the same way as a poultice. Do not allow them to remain too long or the patient will be blistered, five to ten minutes is long enough. Wash the skin after removing the plaster.

The use of *disinfectants* has been already studied in pp. 116-39, Part I.

During any infectious illness the patient's sheets, pillow cases and towels should be *boiled* for half an hour. Woollen and coir fibre articles should be *soaked* for two hours in izal solution. Other textile fabrics can be sprayed with pure carbolic acid solution and *sunned* for several days. Leather articles can be wiped with one per cent formalin solution.

Cooking and eating utensils should be *boiled* a quarter of an hour at least, or, if they would thus be spoiled, *soak* them in one per cent formalin solution. Scrape the walls and whitewash them, burning the scrapings. Scrub everything that will stand it, such as bed frame, furniture and woodwork, windows, etc., with hot soap and water. Earthen

floors can be disinfected with kerosene emulsion with cyanide. Scrub the woodwork and floor in the latrine with mercuric chloride solution. Thus by boiling, scrubbing, sunning everything in the house, you can feel it is safe to live in.

You should now be familiar with the general principles of *prevention* and cure.

In case of sickness, a doctor must prescribe the treatment. We should know enough, however, to meet emergencies, co-operate with the doctor and nurse the patient under his directions. The following tables (pp. 188–93) may be referred to as a help in recognizing infectious diseases. It should guide you in knowing how long after exposure it will be before a specific disease may develop. Then you can isolate the one who has been in 'contact' with disease and determine whether she is going to have it also. In this way, we will protect healthy people and prevent the spread of disease in schools as well as in the home.

Poisons are substances which, when swallowed and absorbed into the blood, will destroy health or even life. Sometimes children swallow cleaning materials, suck matches or taste 'disinfectants' which have been used for sanitary purposes, or eat unsound food which causes ptomaine poisoning. Sometimes poisons are taken deliberately, or over-doses of medicine may be accidentally given. In all such emergencies it is very necessary that you should *know how to act* immediately. A first-aid manual should be kept on hand, for it is impossible to remember the symptoms, antidotes and treatment for all poisons.

What would make you suspect that the person is poisoned? (1) Sudden illness or unconsciousness in a person in good health, (2) the onset of symptoms after eating or drinking.

How can you tell what poison to suspect? Glance around quickly and see if any bottle or box has been left to show

Disease	*Mode of Infection*	*Incubation Period*	*Chief Symptoms, Types of Disease and Remarks*	*Appearance and Character of Rash*
Ague or Malaria	By means of mosquito bites	36 hours to 15 days	Three stages— Hot Cold Sweating	
Chicken-pox	By contact with anyone having disease	4 to 14 days		Red pimples, rapidly changing to small blisters. Appears 1st or 2nd day. Scabs form 4th day come and go
Cholera	From excreta through milk, water, food, dust, flies and clothing	2 to 5 days	Three stages— Diarrhœa Vomiting, cramps, watery stools, suppressed urine, collapse Reaction	
Diphtheria	Through breath carried by cats and fowls	2 to 7 days	Sore throat Hard to swallow	
Dysentery	Same as Enteric	36 hours to 7 days	Characteristics— Diarrhœa Cramp Blood or mucus stools	
Enteric or Typhoid	From excreta and through milk, water, food, dust or flies	14 to 21 days		Red elevated rash appears 7th to 15th day. Disappears under pressure. Found on abdomen. 2nd or 3rd day succession crops to 3rd week

Patient Dangerous to Others	*Period of Isolation*	*Preventive Measures*	*Special Treatment*
As long as the parasites are found in the blood		Exterminate mosquitoes. Protect from bites with a net	Take quinine, 15 grains twice a week.
Two weeks	20 days	Isolation and disinfection	
Until stools are free from cholera bacilli	5 to 10 days	Drink only boiled water or tea. Avoid raw fruit and vegetables. Get the doctor	
Six weeks	12 days	Isolation and disinfection	Anti-toxin injections.
As long as the mucus or bacilli which cause the disease are in the stools	Until patient is well	Isolation and disinfection of excreta	
Eight weeks from first symptoms. May become permanent germ carrier	All contacts and nurses should be quarantined one month	Isolation, disinfect both urine and stools and everything touched by patient. To prevent inoculation. Avoid all fruit without skins and uncooked vegetables. Destroy flies	

Disease	*Mode of Infection*	*Incubation Period*	*Chief Symptoms, Types of Disease and Remarks*	*Appearance and Character of Rash*
Influenza	Through breath, clothing, etc.	1 to 4 days	Breaking out of cold. Sometimes red, bluish or purple. Aching Five types— Catarrhal Nervous Intestinal Gastric Pneumonic	Herpes if present appear around the mouth
Hydrophobia or Rabies	Bites of infected animals—dogs, wolves, cats	7 days to 2 months or even 1 year	Restlessness. Difficulty in swallowing. Convulsions of throat and respiratory muscles. Death due to suffocation or exhaustion Two types— Furious Paralytic	
Measles	By the breath	1 to 2 weeks	Rash behind ears and on forehead and face, on 7th day of fever	Dull red blotches, velvety to touch, appear 4th day of disease
Mumps	By direct contact	14 to 21 days	Painful swelling behind angles of jaws. Difficulty in opening the mouth	
Plague	From rats through fleas	3 hours to 15 days. Usually 2 to 8 days	A rash resembling flea bites is common on face or chest, but not constant Three types— Bubonic Septical Pneumonic	

Patient Dangerous to Others	*Period of Isolation*	*Preventive Measures*	*Special Treatment*
Two to six weeks, according to type	Until well	Strict disinfection and isolation	Treat early. If neglected, many bad results may follow.
A dog or cat which has bitten a person should not be destroyed, but kept under observation for 10 days		Cauterize bites of dog with nitric or carbolic acid. Preventive inoculation at Pasteur Institute.	
Three weeks. Very infectious before rash appears	16 days	Disinfection and isolation	Avoid exposing eyes to light.
Two weeks	12 days	Disinfection and isolation	Do not treat lightly. It sometimes causes death.
Six to eight weeks	12 days	Isolation and disinfection Destruction of rats	Preventive inoculation. Protection of feet and hands and broken surfaces.

Disease	*Mode Infection*	*Incubation Period*	*Chief Symptoms, Types of Disease and Remarks*	*Appearance and Character of Rash*
Pneumonia	Through air, sputum, food or through a third person	16 hours to 5 days	Rigors, cough, headache, rusty sputum. Crisis may be reached on 6th to 8th day	Herpes around nose is common
Smallpox	Through air, from skin and breath	14 days	High temperature at outset and rises when matter appears in pocks. Scabs form on 9th and 10th day and begin to fall on 14th day	Small red pimples, becoming pocks, appear on 3rd day
Scarlet Fever	By breath, mucus discharge, clothing, books, scales from skin	2 to 7 days	Cheeks look as if they had been painted. Pale circle around the mouth. Temperature to 105°. Illness lasts 10 days if no complications	On 2nd day bright scarlet markings on chest. Fades on 5th day of fever
Tuberculosis or Consumption	Through air, from sputum or milk	Uncertain	Fever, wasting, debility, cough. Hæmorrhage from lungs. Duration of disease variable	
Whooping Cough	Through breath or clothing	4 to 14 days or longer	Coughs until blue in the face, and then whoops, vomiting after coughing. Attacks occur 4 or 5 times daily, may occur every half hour	

Patient Dangerous to Others	*Period of Isolation*	*Preventive Measures*	*Special Treatment*
Fourteen days	7 days	Isolation and careful disinfection	Warmth.
A month. The dead are as infective as the living	16 days	All persons coming in contact with case *must* be *vaccinated*	
Six to eight weeks, or until 'peeling' has ceased	10 days	Isolation and Disinfection	
In tubercle of lung exists throughout the disease	21 days	Isolation of infected persons. Disinfection of clothing, etc. Inspection of milk-cows	Sunshine, fresh air, good diet.
While whoop persists	21 days	Isolation, disinfection of sputum, clothing, etc.	

what has been swallowed; note whether the mouth and clothes have been burned, as they would be in case of corrosive poisons; smell the breath, for this may tell you whether carbolic acid, opium or alcohol is the cause; and observe whether the pupils of the eyes are *contracted* as in opium poisoning, or *dilated* as with belladonna (dhatura).

What should you do when you suspect poisoning? (1) *Send immediately for a doctor*, letting him know why he is needed and, if possible, what poison you suspect has been taken. (2) *Begin treatment at once.* Do not wait for the doctor to arrive, as time means everything. Get your manual of first-aid and look up the treatment for the specific poison if you know it. If you do not know the poison, look for the symptoms and judge accordingly what the poison is likely to be. (3) *Rid the system of the poison.* This can most easily be done by causing vomiting. You can do this by giving an emetic. Ipecacuanha is a good emetic which should be kept in the house. The best way to cause vomiting is to give rapidly two tablespoonfuls of mustard in a glass of warm water. A tablespoonful of salt in a glass of water, or even plain water, plenty of it, clean or dirty, will do, if you have nothing else at hand. *Do not give an emetic if there are burns on mouth and lips.* If the poison has burned the mucous membrane in going down, it would burn still more in coming up, therefore we do not make them vomit. In this case, give *milk*, cooked rice, flour and water, or mashed potato, which will sooth the stomach and prevent the poison from being absorbed. (4) *Neutralize* the poison with an *antidote*, if you know what the poison is. An antidote is something which will *counteract* the poison. You have learned in Chapter VII what an *acid* and an *alkali* are. One will *neutralize* the other, or act as an antidote. *If the poison is an alkali*, give something acid such as lime juice or vinegar. *If the poison is an acid*, give chuṇa, bicarbonate of soda or

plaster. After the antidote has been given it is usually safe to give an emetic. (5) *Stimulate the patient.* In many cases of poisoning there is collapse or drowsiness and the patient will require either warmth to the feet or artificial respiration, or to be kept walking to prevent him going to sleep. Stimulants may have to be given, such as hot tea or coffee.

What are the chief groups of poisons? (1) *Narcotics*, poisons which produce sleep, such as *opium* and its preparations, such as *laudanum*, *dover-powders*, *paregoric*, *heroin*, *morphia*, *chlorodyne*. The symptoms are drowsiness, unconsciousness, pulse fast and then weak, breathing slow and shallow, face flushed, clammy sweat, *pupils of eyes contracted*, breath smelling of opium. The treatment consists of an *emetic* to produce vomiting followed by a *stimulant*, tea or coffee. Give solution of 10 grains of permanganate of potash to 1 seer of water; walk and slap the patient to keep him awake. Repeat the emetic. Give artificial respiration if there is collapse and insensibility. (2) *Irritants.* These are metallic poisons, such as *arsenic* and *mercury*, *powdered glass*, *kerosene oil*, *ptomaine.*

Arsenic is found in salvarsan, Paris green, and rat poisons. *Arsenic poisoning much resembles cholera.* Symptoms are pain in stomach and abdomen, vomiting, thirst, bloody movements of bowels, rapid weak pulse, clammy skin and sometimes unconsciousness. Treatment: (*a*) Give emetic of warm salt water; (*b*) give milk, flax seed tea or brandy and olive oil; (*c*) if bowels have not moved, give castor oil. Similar treatment may be given in case of kerosene oil and turpentine, phosphorus and ptomaines.

Mercury preparations are used as disinfectants and are very poisonous, causing great pain. Symptoms are metallic taste in mouth, white swelled mucous membrane, pain in abdomen, nausea with vomiting, and bloody stools; skin clammy, prostration and collapse. Treatment: (*a*) Give

flour and water and milk; (*b*) emetic, such as salt and water; (*c*) lemonade and brandy.

For powdered glass, give large quantities of bulky food such as bread, rice. potato, to mix with the glass and protect the walls of the stomach; then give an emetic.

(3) *Corrosive poisons* are substances which destroy tissues such as strong acids and alkalies. In this group, sulphuric and nitric acids, and alkalies such as ammonia, caustic soda and potash. Symptoms of *acid poisoning* are burned lips and mouth, often stained white, yellow or black; pain in the alimentary tract; intense thirst, vomiting; difficulty in talking; collapse. Treatment: *Avoid emetics*; give whitening, plaster, chalk, mixed with water; follow this with half pint of oil (olive or sweet) in one pint of water; give milk *freely*. Carbolic acid is different in character and is recognized by symptoms of white stain of burned lips and mouth, and by odour. The muscles become soft and useless; collapse. Treatment: *Avoid emetics*. Give Epsom-salts or sulphate of soda (½ oz. in ½ pint of warm water or milk); give milk freely, or limewater and milk, flax seed tea, or raw eggs. and also alcohol; warm the feet and give artificial respiration; do *not* give *oil* or glycerine, as they hasten absorption of poison. Strong alkalies, such as ammonia, caustic soda and potash. Symptoms are vomiting and purging, with pain in straining; collapse. Treatment: *Avoid emetics*; give vinegar or lime or lemon juice, with equal parts of water; milk freely; olive oil (¼ pt. to 1 pt. water).

(4) *Nerve poisons*. In this group we place prussic acid and cyanide of potassium, cocaine, mushrooms, strychnine and nux vomica; belladonna, dhatura, alcohol, hemp or bhang. These substances produce delirium or excitement. Symptoms vary in some particulars (see first-aid manual); but in general, *pupils of the eyes are enlarged or dilated*, giddiness and staggering, excitement occurs, and then quiet

followed by insensibility. Treatment: *Give emetics*, and then *stimulants*, warmth and artificial respiration; in the cases of mushrooms also give a *purgative* (2 oz. castor oil).

The nurse. In selecting the member of the family who shall act as nurse in case of sickness, what are the special qualifications we would look for? In the first place she should herself be well and of strong constitution. She will then be less likely to contract disease herself and will have the strength to endure the strain of nursing. She is more likely to be optimistic and cheerful also. Anyone *interested* in nursing is bound to succeed better than one who merely acts from a sense of duty. She should be *gentle* and *kind*, both in word and deed, making the patient feel that the services rendered are done willingly. At the same time, she must be *firm*. If she is *observant* she will better understand her patient's needs and thus control him. These qualities, combined *observation* and *sympathy*, are most important. She will be *patient* even when he is irritable and *cheerful* in the face of discouragement. Cheerfulness is worth more than medicine often. She must be *accurate* in observation and in reporting her observations to the doctor. She is never careless in the performance of duties of all kinds.

The nurse must possess *presence of mind* and keep calm and courageous in the face of every emergency. *Promptness* in thinking and acting is a necessary virtue at all times. *Orderliness*, too, is most important in the care of rooms, patient, medicines and all details of nursing. She must be *quiet* in manner, speech and actions. Her work must be *thorough* in all details. She must *obey* the doctor's instructions implicitly and prove that she can be *relied* upon. Her own dress and person must be sweet and clean and she should especially see that her hands are kept smooth and clean. A nurse must be *unselfish*, trying to put herself in others' place and 'do unto others as she would be done by'.

AGENDA

Oral and Practical

1. What would guide you in your choice of room which an invalid should be given?
2. Why is it necessary for a nurse to be skilled in making a bed?
3. How can bed sores be prevented?
4. What is the normal pulse rate and temperature of a girl of your age?
5. Why are records important in nursing? How should they be kept?
6. What temperature would cause you to send for the doctor?
7. What precaution must we take before giving medicine?
8. How would you disinfect a room?
9. What is your duty towards the doctor?
10. Study the table for symptoms of the various diseases, in order that you may be able to recognize them in time to send for the doctor or to give treatment yourself.
11. What are the qualifications and characteristics of a good nurse?
12. Test yourself as to whether you can answer all the questions about poisons and if you are prepared to give first aid.
13. Name all the uses to which the medicines given at the beginning of the chapter may be put.

Exercise 7

1. Practise making a bed, without and with someone lying on it.
2. Practise moving and lifting a patient in bed.
3. Practise taking each other's temperature, pulse and respiration.
4. In the cooking class, practise preparing and serving a tray for an invalid.
5. Practise making poultices and stupes and plasters.

REFERENCES

Indian Manual of Home Nursing.
Indian Manual of First Aid.

CHAPTER X

SCIENTIFIC PRINCIPLES

'In every work, the beginning is the most important part.'—*Socrates.*

Required:—Camphor gum, salt, dye, sugar, wheat kernels, ammonium hydroxide, hydrochloric acid, magnesium ribbon, potassium chlorate or manganese oxide, iodine, litmus paper, sheet zinc, turpentine, caustic soda (sodium hydroxide), soda bicarbonate, sour milk, ignition tube, evaporating dish, chatti, forceps, glass delivery tube, corks, test tube, bottles, glass covers, dry wood splinters and shavings, charcoal, fine copper wire, cardboard, quicklime, candle, ghee or oil, rubber tubing, alcohol lamp or clay-chiragh, cotton wick, glass tumbler, plate, paper, matches, a pulse plant with roots and tubercles, microscope.

One of the marks of education is an increased *power of observation.* The world is a wonderful place, but much of its beauty and wonder is ignored by the ignorant. You should try to cultivate the ability to *see accurately.* If you do not understand what you see, seek knowledge which will explain the problem to you. Did you ever wonder what becomes of lost pins and needles? Do you wonder what makes the fire burn? Interest in the phenomena about us and desire to understand it are the first essentials of scientific method. The answers to these problems have been discovered by observation and *experiment.* Would you like to try some of the experiments by which the physical and chemical principles controlling matter have been proved? What is *matter*?

It is usually described as 'anything which occupies space'. You have already learnt that there are three forms of matter—*gaseous*, *liquid* and *solid.* Can you name and

classify some forms of matter? Sometimes the same matter assumes different forms under different conditions of temperature. As an example, water is liquid under ordinary conditions, but when it freezes it is solid and, when we boil it, it takes the form of vapour or gas. Air is usually a gas, but it can by great pressure, under conditions of extreme cold, be compressed into liquid form. You will remember you were told in Part I that matter is made up of great numbers of tiny particles, so small that you cannot see them without a powerful microscope, and that these particles are called *molecules*.

Lord Kelvin estimated that if a drop of water were magnified to the size of the world, the molecules of which the drop is composed would appear smaller than a cricket ball. Molecules are the smallest form into which matter can be divided *without changing its nature.* You must know that molecules of each pure substance are exactly like one another, but different from the molecules of every other substance. The molecules of a substance cannot be subdivided without destroying the substance, that is, without *changing it into other substances.*

Experiment 40. Take a piece of *solid* camphor gum and place it in an evaporating dish and heat it gradually. Note the change of form. Be careful not to burn it as you continue to heat it and see what happens. What becomes of the camphor?

Now we will try some other experiments and see how you can interpret the results.

Experiment 41. Take a small amount of salt and dissolve it in water. Taste the solution. Can you see the salt? Can you taste it? Add more and more water as long as the salt can be tasted. Imagine, if you can, what tiny particles of salt there must be when divided up in so large a quantity of water.

Experiment 42. Take a little dye and dissolve it in a large

vessel (*chatti*) of water. Are the particles of dye present in all parts of the water?

Experiment 43. Put a small piece of *solid* iodine into a bottle and cork it. Heat it slowly and watch the solid change to gas. The tiny particles, of which iodine is composed, are driven apart by the heat, filling the bottle (Fig. 112).

These experiments tell us truths which we can interpret if we understand the principles. They answer questions about nature and matter. Do they explain to you the structure of matter? Scientists conclude, from these experiments and others, that matter is made up of molecules and that the molecules are in *motion*. It is believed that heat causes the molecules to move faster. They account for *physical changes* by explaining that there has been a change in the *arrangement* of the molecules with one another, or a change in the rate of *motion* of the molecules.

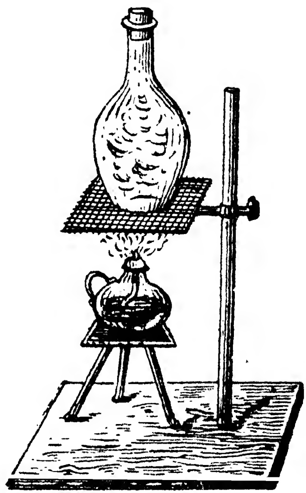

Fig. 112
Solid iodine when heated changes its form to gas

'A group of molecules make a *mass* of matter.'

Can you understand now how matter can change its shape? In a *solid* the molecules are held so firmly together that they cannot move about freely and the solid must keep its shape. In a *liquid* the molecules are not held so tightly together and can slip about over each other, so that they take the shape of any vessel in which they are placed. But the molecules in a *gas* fly apart as far as possible from each other and do not hold together at all.

If you watch matter about you, you will soon discover that it is *constantly changing*. The milk you buy one day thickens and is sour the next. The wood rots, the iron rusts, etc. Some of the changes are only *temporary*, that is, the matter can be made to return to its original form. The change of water to ice or steam is such an example. Wax can be melted and will harden again. These *temporary changes are called physical changes*. You study about these in the science called *Physics*.

But sometimes the matter changes its form *permanently*, so that its old qualities are gone, like the change when milk sours and iron rusts, or fruit decays and wood is burned. When a substance loses its former qualities and takes on new ones, it indicates that the substance has been broken up and new substances have been formed. Such changes are known as *chemical changes* and they are studied in the science called *Chemistry*.

Experiment 44. Put some sugar, preferably white crystallized sugar and heat it in a test tube or iron pan. You will notice that it changes colour and melts. Presently it becomes black. Taste it and see if it tastes as it did before it was heated. The change has taken place which has produced a different substance called carbon or charcoal. What kind of change is this?

Experiment 45. Take some wheat kernels and chew them for a while without swallowing. Do you notice a change in taste? The change in taste is due to the starch molecule in the wheat having been changed by the ptyalin of the saliva to sugar and that is why it is sweet.

A chemical change has taken place and this can be understood by remembering that the *molecules are made up of still smaller particles* which we call *atoms*. 'These are the smallest particles into which matter can be divided by chemical change.' When we heated the dry white sugar, the sugar molecules were broken up and new substances were produced from the atoms that were in the sugar

molecule. You can see one of these substances left in the test tube or cooking pan, which we know to be *carbon.*

Elements. A substance which has only *one kind of atom* is called an elementary substance or, more commonly, *an element.* There are over eighty of these elements known to scientists. Many of them are rare and we usually study only thirty-five elements and their compounds in Chemistry. Gold and silver are familiar examples of elements having only *one kind* of atom. Iron is an element, because its molecule is made up of two atoms of iron. Oxygen, nitrogen, hydrogen and carbon are all common elements of which we must know more if we are to understand the air, water and food which are necessary to life.

A great majority of the solid elements and one of the two liquids (mercury) are classed as *metals.* Metals have certain chemical and physical properties. They have a bright lustre when polished; good power for conducting heat and electricity. Some of the metals are iron, tin, zinc, copper, silver, gold, also sodium, potassium, calcium and radium.[1] Among the *non-metals* are solids like carbon, sulphur, phosphorus and iodine, the liquid bromine and all the gaseous elements.

Compounds. When a molecule is made up of *more than one kind* of atom, it is called a *compound.* The water molecule is made of two atoms of hydrogen and one atom of oxygen linked together. When you combine elements in various ways, you can realize how many thousands of compounds can be made through chemical action.

Molecules, usually, are made up of two or more atoms, but there are a few substances, such as zinc, mercury, sodium and some others, which have only one atom in the molecule in their elementary form. We may now define *Chemistry* as '*the science of the atom and of how atoms combine with each other to form new molecules and substances*'.

[1] The ending '*ium*' indicates that the substance is a *metal.*

Experiment 46. Take two tumblers and set them at least a yard apart. Rinse one with ammonium hydroxide and the other with hydrochloric acid. Cover one with a piece of paper and bring it to the mouth of the other, fitting one on top of the open mouth of the other. Draw away the paper and notice the change that takes place. The liquid adheres to the sides of the glass and speedily evaporates, forming a gas (Fig. 113).

The molecules of these two gases have evidently been broken up and the atoms re-combined to build the white solid which has been formed and which is called ammonium chloride. What kind of change is this?

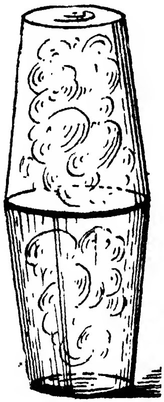

Fig. 113

Ammonium hydroxide and hydrochloric acid combine to form ammonium chloride.

Experiment 47. Hold a piece of magnesium ribbon with a pair of forceps in a flame. What happens? The silvery, soft metal is changed to a white brittle substance called magnesium oxide.

It takes too long to write out the names of the elements and the number there are in a compound, so a system of symbols has been devised. We use the first letter of the name of the element. Sometimes the English name for the element and sometimes the name in the Latin language is used. If you learn these symbols you will find it easier to understand the chemistry of compounds. In order to show how many atoms there are of each element in a compound, we place a small number to the right and a little below the symbol of the element. To write the symbol of water we would make it like this—H_2O, which would show that there were two atoms of hydrogen and one of oxygen in a molecule of water. If you wished to write how *many molecules* of water were used, place the numeral *before* the molecule, 6 H_2O. Carbon

dioxide would be symbolized as CO_2, showing that there was one atom of carbon and two atoms of oxygen in every molecule. When molecules are broken up by a chemical change, the atoms are never destroyed, but they are separated from each other and unite with other atoms immediately to form new compounds.

Element	*Symbol*	*Element*	*Symbol*	*Element*	*Symbol*
Aluminium	Al.	Hydrogen	H.	Phosphorus	P.
Arsenic	As.	Iodine	I.	Potassium	K.
Bismuth	Bi.	Iron	Fe.	Radium	Ra.
Bromine	Br.	Lead	Pb.	Silicon	Si.
Calcium	Ca.	Magnesium	Mg.	Silver	Ag.
Carbon	C.	Manganese	Mn.	Sodium	Na.
Chlorine	Cl.	Mercury	Hg.	Sulphur	S.
Copper	Cu.	Nickel	Ni.	Tin	Sn.
Fluorine	F.	Nitrogen	N.	Zinc	Zn.
Gold	Au.	Oxygen	O.		

Oxygen. The Chinese, about the eighth century, knew that there were two components of air, and that the active one, *yin*, combined with some metals and with burning sulphur and charcoal. They even knew that it could be obtained in pure form by heating certain metallic compounds, of which one was saltpetre.

Experiment 48. Would you like to obtain some of this active part of the air? If so, it can be done by heating potassium chlorate or manganese oxide, or a mixture of both (three parts of the first with one part of the second) in a test tube. Fill the tube about one-third full. Put a small delivery tube through a cork and close the test tube with the cork. Support it in a slanting position and heat the upper part of the mixture first (see Fig. 114). This must be done carefully. You can collect the gas in bottles filled with water and inverted in a chatti of water. Remove the bottles of gas and cover them carefully. Stand them upright and keep them covered. Why?

Note.—Remove the delivery tube from the water before the lamp is taken away from under the test tube.

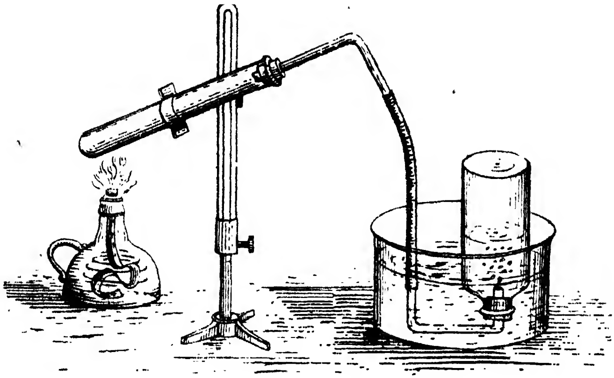

Fig. 114
Preparing Oxygen

Now we have some *oxygen.* Note that it is colourless, tasteless and has no odour. The air about you is about one-fifth oxygen. Eight-ninths of water is oxygen and half of the earth's crust is oxygen. Its atoms are so active that they unite with the atoms of other elements and form compounds of many kinds. This you will find to be true of plant and animal substances which we use as foods.

Let us prove that oxygen is active by a few experiments.

Experiment 49. Light a dry stick of wood and let it burn at the end until a red coal is formed and then blow out the flame. If you put this quickly into one of the bottles of oxygen, it will again burst into flame. The gas itself does not burn, but the stick does. We say, therefore, that oxygen *supports* combustion.

Experiment 50. Take a small piece of charcoal such as you use in the segri and fasten it on to a fine wire and put the wire through a piece of cardboard. Light the charcoal and, when glowing hot, put it into a bottle of oxygen. The cardboard will keep the bottle closed. Watch how rapidly it burns the coal up (Fig. 115).

What is left in the bottle? We put charcoal, which is composed only of carbon, into a bottle which contained only oxygen. What has taken place? The atoms of oxygen have united with the atoms of the carbon and formed a new *compound*. We call it *carbon dioxide*.

The chemists describe the action in this form:

$C + O_2 = CO_2$, or, carbon plus oxygen produces carbon dioxide. There is a simple test for this gas which you can all use. But first it will be necessary for us to make some limewater.

To make limewater. Take some fresh chuna or quicklime and grind it up fine. Place it in a bottle of clean water. Shake it frequently and then let it stand to dissolve as much of the lime as possible. Then let the excess of lime settle in the bottle. Pour off the clear liquid into another clean bottle and put a clean cork in it.

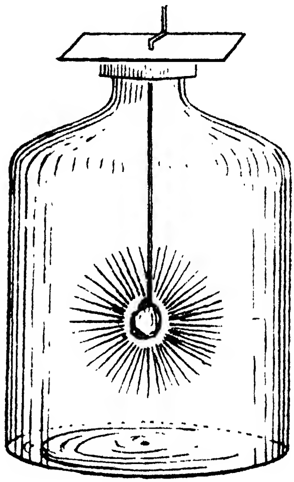

Fig. 115

Charcoal burning in a bottle of oxygen

(From *Science for Beginners*, by Dr. D. Fall. World Book Co., New York, 1920.)

Experiment 51. Place some of the limewater in a saucer and let it stand in the air. After a time examine it and note the change that has taken place.

Put some limewater into a test tube or small bottle and blow your breath into it, shaking the breath into the limewater. What happens?

The white cloudy appearance is proof of the presence of carbon dioxide.

Since oxygen is so active and there is so much of it in

the air, you may wonder why everything in the world does not burst into flame. The Chinese, we learned, discovered *two* elements composing the air and one of them is *in*active. We will learn more about it later.

Burning of a candle

Experiment 52. *Moisture is formed when a candle burns.* Over a burning candle hold a clear cold inverted tumbler which has been carefully dried inside and out. Notice that the inside of the tumbler becomes covered with mist, and after a short time drops of *water* are formed, which run down the sides of the tumbler (Fig. 116).

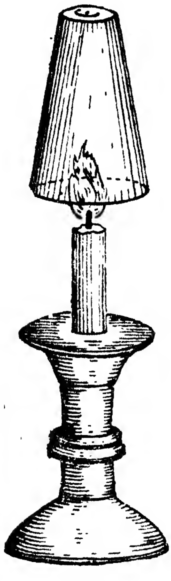

Fig. 116

Hold the tumbler over a flame and note the moisture formed inside

Experiment 53. *Properties of the gas left after a candle has burnt in air*

Wind a piece of copper wire round a small candle and light the candle. Push the top of the wire through a small hole in a disc of cardboard and then lower the candle into a dry clear glass bottle in such a manner that the top of the jar is covered by the cardboard disc (Fig. 117). Observe that the flame of the candle becomes dimmer and dimmer, and soon goes out altogether. Water collects on the inside of the jar, as in the last experiment. Take out the candle and cover the jar with a greased glass plate. Quickly insert a burning taper, or the re-lighted candle; it is at once put out. Pour in a little fresh, clear limewater and shake it up in the jar; notice that it is turned milky. What does this prove?

It has been shown that a candle will not continue to burn very long in an enclosed quantity of air. Unless the air is renewed in some way, the light of the candle goes out. Why does the light go out? What changes take place when the candle is burning?

Substances containing one element in combination with oxygen are called *oxides.* All substances ending in *ide* contain only the elements mentioned in the name. When carbon is combined with oxygen in burning the wood or candle, we get carbon dioxide, or CO_2. *Di* means two and indicates that there are two parts of the oxygen present.

Since oxygen is a component of air, we are familiar with many chemical actions in which it plays a part. This union of oxygen with substances such as wood and oil is popularly spoken of as *combustion.* Power and heat for making the railway engine run are obtained by burning coal. Oxygen for burning it is taken from the air and costs nothing. If we had to buy it, we would need to purchase three times as much oxygen as coal.

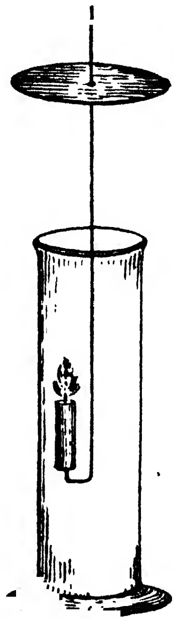

Fig. 117

Lower a candle into a bottle and cover with a disc of cardboard for cover

Oxygen may combine *rapidly* with substances when heated, or *slowly* in the cold, as in rusting of iron or decay of wood. We mix large quantities of water with sewage and the oxygen in the water helps to oxidize the matter and with the aid of the bacteria to change the matter into carbon dioxide and water, thus purifying it.

Slow oxidization also takes place in our bodies, as we have previously learned in the chapters on Respiration and Digestion. The oxygen from the air is taken into the lungs, where it combines with the hæmoglobin of the blood. It is carried over the body to the tissues and there oxidizes the food which has been absorbed. The same products of oxidization are formed in the body as outside it, that is, water and carbon dioxide. The carbon dioxide

is carried back to the lungs and exhaled. During the process of oxidization, *heat* has been given off, which is used to keep the body warm and furnish energy for work.

When a chemical change takes place, it is noticeable that *heat* is either absorbed or liberated and this fact is more important to us than the change in the matter itself. 'We do not burn the charcoal and wood to manufacture carbon dioxide gas, but to *secure the heat* to cook with. It is the same in burning oil in our lamps or candles—it is *the light we want*. So, when we eat food, our chief concern is to get *energy for work and play*. The amount of energy which substances liberate when eaten is an important aspect of food study. Let us remember, then, that all materials are repositories of *energy* as well as of matter. Thus 'by a *substance* we mean a distinct species of matter, simple or compound, with its *appropriate proportion of internal energy*'.

Hydrogen. Hydrogen is the lightest substance known. We find it helping to form the composition of everything of plant or animal origin and, as we shall see, it is one of the chief components of water. Shall we collect some and compare its properties with those of oxygen?

Experiment 54. Fill a test tube half full of water and put only five or six *drops* of hydrochloric acid into it and stir it thoroughly with a glass rod. Touch it on the tongue. What does it taste like? Is it sour? The taste is due to the hydrogen which is set free when the acid is dissolved in water.

Caution.—Hydrochloric acid is dangerous.

Experiment 55. Test the mixture with blue litmus paper. An acid will turn blue litmus red.

Experiment 56. Add more acid to the solution of water and hydrochloric acid. Drop a small piece of sheet zinc or magnesium into it. Notice the bubbles of gas which arise

from the zinc to the surface of the water (Fig. 118). This gas is *hydrogen.* Light a match and *hold the test tube away from your face* before bringing the match to the mouth of the test tube. A slight explosion will be caused. This is one of the proofs that it is hydrogen.

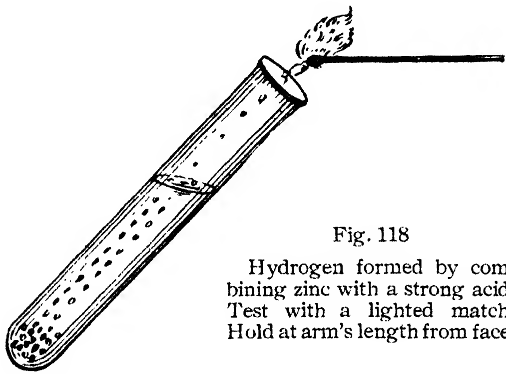

Fig. 118

Hydrogen formed by combining zinc with a strong acid. Test with a lighted match. Hold at arm's length from face.

Experiment 57. Fit a tight cork into the test tube, with a small delivery tube thrust through it. *Let the air first pass out* and then put a lighted match to the end of the delivery tube and light the gas (Fig. 119). Notice how blue the flame is.

Caution.—If you do not let all the air out of the tube before lighting it, you will have a violent explosion, for hydrogen mixed with air is very explosive.

Experiment 58. Take a clean and dry glass bottle or tumbler. See that it is as cold as possible and hold it over the hydrogen flame. Notice how *water* condenses upon the cool glass. Can you explain what it is that is uniting with the hydrogen to make it burn? Can you see from this experiment any proof that water is made of hydrogen and oxygen?

Experiment 59. If you attach a piece of rubber tubing to the end of the delivery tube, you can collect the hydrogen gas as you did the oxygen, into several bottles.

Experiment 60. Then carefully lift one of the bottles filled

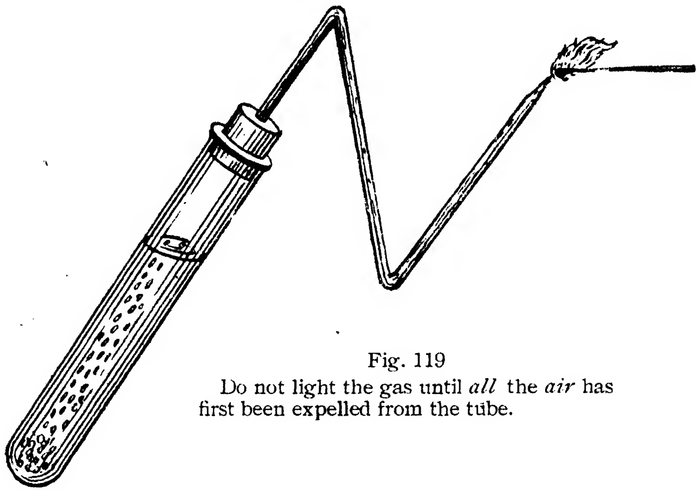

Fig. 119
Do not light the gas until *all* the *air* has first been expelled from the tübe.

with gas. *Do not* turn the mouth of the bottle *up*, or the light gas will be quickly lost. Light a candle on a splinter of dry wood, as you did in the experiment with oxygen and push the flaming wood up into the mouth of the bottle of gas. Now notice two things—first, that the gas itself will burn at the mouth of the bottle or test tube with a clear blue flame that is very hot. Secondly, the flame of the burning stick will be extinguished. You can re-light it by pulling it out to the mouth of the bottle and extinguish it again by thrusting it in.

How will you now describe hydrogen gas? Does it behave in the same way as the oxygen behaved? No, *it will itself burn*, but *cannot support combustion.* Take your note-books and write down the properties of oxygen one under the other and opposite this write the properties of hydrogen and see how they differ. Hydrogen is lighter than air. Is oxygen? Hydrogen is combustible. Is oxygen? Hydrogen will *not* support combustion. Will oxygen?

Seeing how different both these elements are from each other, though both are gases, it is even more of a surprise

to see the form they assume when united as *water* (H_2O). This is an extremely important fact for you to understand and remember, ***that when elements unite to form compounds, the compounds are usually utterly unlike the elements from which they are made.*** I am sure you would never have imagined, if you had not proved it, that two gases with such very different properties were combined to form water. We see how the properties of the compound formed are wholly different from either gas.

Later you can prove this fact by experiments with other elements and compounds. We will try one now if you wish, with *turpentine*, to see of what this liquid is made. We will also illustrate what we have been saying—*whenever two or more elements unite by chemical action, both lose the properties they originally possessed and form a compound having entirely different properties.*

Experiment 61. Take a small amount of turpentine and observe how clear it is. Smell its peculiar odour and note that it is a liquid. Put some into a small clay vessel with a cotton wick, or in an alcohol lamp and light the wick. Hold a glass tumbler over the flame. There will be a black solid mass formed in the glass, which is *carbon.*

The other element in turpentine is hydrogen, so the carbon must have come from the turpentine, too. Does it look like turpentine? Turpentine has the formula $C_{10}H_{16}$.

Acids. When you tasted the hydrochloric acid, you said it was sour. There are many other things which taste sour. Name some of them and test them with the blue litmus paper.

All acids contain hydrogen which is liberated or set free when it comes in contact with a metal. ***An acid is a compound from which hydrogen can be obtained.*** Most inorganic chemical compounds are classed as ***acids, bases*** or ***salts.*** We will learn more of the other two classes later. Now let us sum up the properties of acids and write them

in our note-book. First, what do they taste like? Second, what reaction do they give to litmus paper? Third, what do they contain which can be set free by action on a metal?

Bases. In the last lesson we studied about acids and tested them with litmus paper. Perhaps you found some substances which did not change the blue litmus to red? These substances may have made the blue paper a deeper blue. Try what effect they would have on red litmus paper. Substances which, when dissolved in water, change red paper blue are called bases and are alkaline in their reaction. What happens when you test chuna and soda? Taste them and see whether they taste the same as acids. Do they burn your tongue? *Bases always contain a metal with oxygen, or oxygen and hydrogen.* Write these characteristics in your note-book and compare them with the acids.

What will happen if we put an acid and a base together? Let us try another experiment and see.

Experiment 62. Put some hydrochloric acid into a glass tube about one-third full of water. Test it with the blue litmus. Is it acid? Now take a solution of caustic soda, known as sodium hydroxide. Pour this gradually into the acid solution, testing it constantly with the litmus. When the litmus begins to change to blue again very faintly, stop adding the solution. Keep this material in the test tube for another experiment.

What have you done? Can you explain it? Whenever an acid and a base are brought together they *neutralize* each other. The acid destroys the alkaline of the base and the base destroys the acidity of the acid. We make use of this fact in our cooking. We also apply this principle in treating some cases of poison. If the milk turns sour, we put soda into it to neutralize the acid. Now, can you explain why you add chuna to kamrak?

Salts. What has become of the acid and the base when you neutralize them? Let us take the solution we have saved and experiment again.

Experiment 63. Place the solution in an evaporating dish and heat it until you have driven off all the water. What do you find in the bottom of the dish? Taste it. Surely you recognize that taste. Where did the salt come from?

Now we have learned another chemical fact. *A salt is formed when an acid and a base neutralize each other.* There are many, many kinds of *salts* formed in this way, not only nimak. In this particular case it is nimak or salt, and with the chemical symbols we can show you what happened.

$$NaOH + HCl \qquad NaCl + H_2O$$

$$\left.\begin{array}{r}\text{Sodium hydroxide } + \\ \text{hydrochloric acid } =\end{array}\right\} \begin{array}{c}\text{sodium chloride} + \text{water} \\ \text{(or salt)}\end{array}$$

The sodium of the base changed places with the hydrogen of the acid. Now we want to understand this thoroughly, for it is a fundamental truth. Whenever an acid and a base act on each other, they exchange atoms. The acid gives the base its hydrogen and in exchange receives a metal. Can you remember this? The sodium joined the chlorine and formed salt. The hydrogen joined the oxygen and formed water. This type of action is called *neutralization* in Chemistry. One product of such action is always *water* and the other is a *salt*.

In previous chapters, we have learned how important water is to the functions of the body and its tissues. Later we are to see how large a proportion of our foods are composed of water. We will also consider its importance in the cooking processes, as well as its uses as a solvent in cleaning.

Salt may be examined under the microscope to discover the shape of the particles.

Experiment 64. Place a pinch of salt on a piece of black paper and examine under the microscope.

Experiment 65. Dissolve some salt in a little water and place it in a saucer. Let it stand in the sun and evaporate

the water. Examine this under the microscope and describe the *crystals*. What shape are they?

Now let us examine it *chemically* to see of what it is made and how it behaves when placed with other substances.

Experiment 66. To a small amount of salt in a test tube add a few drops of sulphuric acid. Has a chemical change taken place? Smell the gas carefully which comes from the tube. Notice how sharp the odour is. Now blow your breath across the top of the tube and see the white cloud formed. Test it with blue litmus paper. This gas is known as *hydrochloric acid.*

Experiment 67. Place a solution of salt in a test tube and into it dip a piece of platinum or iron wire which has a small loop in its end. Hold the drop close to the colourless part of the lamp flame and notice the brilliant *yellow* colour of the flash. The yellow colour thus produced is a *proof* of the presence of *sodium.*

You will remember that substances whose names end in *ium* are *metals*. What is it combined with the sodium to form our common salt?

Experiment 68. Mix some salt with black oxide of manganese (MnO_2) in a test tube. Pour a few drops of sulphuric acid on the mixture and warm the mixture *near* a flame, but *not* in it. A *greenish*-yellow gas with strong odour is given off. *Take care not* to breathe any of the gas. This gas differs from the hydrochloric acid. It is known as *chlorine*, with the symbol Cl. The chlorine must have come from the salt, for there is none in the manganese *oxide*, nor in the sulphuric acid (H_2SO_4) which contains only hydrogen, sulphur and oxygen.

Matches. You cannot determine on the chemicals used in making matches by experiment; but you can learn to recognize two that are commonly used—*phosphorus* and *sulphur.*

Experiment 69. Strike different kinds of matches and observe how they burn. Some give a little *cloud* of smoke

as soon as the match is lighted. Some, you will see, burn with a *blue* flame and have a stifling *odour.*

It is known that the element *phosphorus* gives off a white cloud, composed of fine particles of white solid produced by the union of the phosphorus of the match with air. It is an oxide of phosphorus (P_2O_5). The *blue* flame suggests *sulphur* and the odour is that of *sulphur dioxide* (SO_2), produced by the union of sulphur and oxygen. You will learn in the next chapter of the importance of these elements and of iron in the nourishment of our bodies.

Lime or *chuna.* Do you know where you can find some limestone? Pure crystallized limestone is called Iceland spar. Of what is it composed?

Experiment 70. Put a piece of limestone into a test tube and add a few drops of acid. Notice the gas given off. It is heavy and can be poured off. In another test tube put a little *limewater* and pour the gas given off from the limestone into it. Shake the test tube to mix them. Note the white precipitate. Where did the carbon dioxide come from? It was not in the acid.

Experiment 71. *Heat* thoroughly some pieces of limestone in a segri and examine it. It will become soft and brittle. Test it with acid. It will not effervesce if it has been sufficiently heated. The heat has changed it into quicklime, or *chuna* as we call it.

The chemical name for limestone is *calcium carbonate* ($CaCO_3$). By heating it we drove off the carbon dioxide, leaving the calcium and one atom of oxygen, in the form of *calcium oxide*, or quicklime (chuna). $CaCO_3 = CaO + CO_2$, or limestone = quicklime + carbon dioxide.

Experiment 72. Take some fresh lumps of quicklime (calcium oxide) in a chatti and drop some distilled or rain water upon it, little by little. Does it give off a sound like steam? Indeed, steam can be seen rising from the heat produced.

$$CaO + H_2O = Ca(OH)_2$$

lime + water = calcium hydroxide (slaked lime).

If you continue to add water until the lime is dissolved, you can let it settle and pour off the liquid which is *lime-water* or $Ca(OH)_2$.

When you breathe CO_2 into limewater you reverse the chemical process. The white precipitate produced is *lime-stone*, formed by the carbon dioxide re-uniting with the lime-water. $Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$, or limewater + carbon dioxide = limestone + water.

When we use this test for carbon dioxide gas, we are really manufacturing limestone.

We use slaked lime to whitewash our houses. The bricklayer mixes it with sand to form plaster. When the whitewash and plaster are exposed to the air, they take up carbon dioxide and form again into limestone. Our chalk, which we use on the blackboard, is soft limestone.

Later we will see the uses of lime, or *calcium* as it is called, in our bodies. It is one of the most important building materials for our own bones and teeth.

There are twenty different mineral elements in our bodies, composing $\frac{1}{25}$th of it. From these elements many kinds of mineral salts are made. These elements are grouped as 'ash constituents', 'mineral salts', or 'inorganic elements'.

Carbon. If you look at the tables giving the composition of foods (p. 226), you will see that carbohydrates and fats are composed of hydrogen, oxygen and carbon. We want to understand this third element a little better before we can discuss these foods.

Carbon is very abundant in everything which grows. It is a part of all animal and vegetable life; indeed, everything which lives and grows contains a large amount of carbon. We speak of these as *organic* substances. In the segri we use charcoal to cook our foods. We use it in our houses where we have no chimneys, because it will burn slowly and

without smoke. (*Caution.*—Remember that unless the room is well ventilated people may be *asphyxiated* and die.) What is charcoal? Would you like to make some?

Experiment 73. Take an ignition tube which is provided with a glass delivery tube. Put some shavings of wood into the tube and heat it over a flame. Gases will pass away through the tube which you can light. After they have passed off, close the tube tightly with a solid cork and let the tube cool. What do you find inside? Does it look like charcoal? What are its properties?

Write the list of properties in your note-book as you did with oxygen and hydrogen, for this is an element also. It is one form of carbon. Has it taste? What does it smell like? How does it burn? How do you get the black *kajal* which you use to darken babies' eyes? Do you get it from burning ghee? This, too, is carbon.

Experiment 74. Hold a cold plate over a flame of burning oil or ghee and the carbon will be deposited on the surface. The cold plate lowers the temperature of the flame below the burning point of the carbon and so it is left unconsumed on the plate.

Your pencils are made of graphite which is another form of carbon. Diamonds are another form of carbon, although they are not black.

Carbon dioxide. When we burn charcoal in the segri we obtain heat and we now know that water, too, is formed, but it evaporates into the air without our seeing it. There is something else formed which we cannot see, but which can be proved by the limewater test; this is carbon dioxide. Can you tell its composition from its name? *Di* means two, and therefore we know that this substance contains two parts of oxygen and one part of carbon. Its formula is CO_2.

Apply test for carbon dioxide.

Whenever any organic substance is burned in the air, the

oxygen will combine with the carbon and form carbon dioxide. You have already learned that, when we breathe air into our lungs, the oxygen is used to burn the food and we breathe off carbon dioxide.

You can make carbon dioxide in other ways. In our cooking we use this gas to make bread light. When soda bicarbonate is put into sour milk, a gas is evolved which you can collect in a glass bottle and test with limewater. Test this and see for yourselves. Baking powders owe their value to the formation of this gas. Similarly, yeast produces it when growing in the dough and so the bread is made spongy.

Carbohydrates are a class of foods which contain the elements, carbon, hydrogen and oxygen. The hydrogen and oxygen always occur in the same proportion that they do in water, that is, two of hydrogen to one of oxygen (H_2O). We will not discuss the classes of carbohydrates chemically, beyond showing the formula for the most well-known foods and indicating how they are built up and how they are again broken down. The symbols for *fruit sugar* is $C_6H_{12}O_6$, and the *synthesis* (building up) of this is shown by the formulæ $6\ CO_2 + 6\ H_2O = C_6H_{12}O_6$, carbon dioxide + water = glucose.

Cane sugar is composed of the same elements in a slightly different proportion, $C_{12}H_{22}O_{11}$. When water is added to cane sugar and heated, the two combine chemically by a process called *hydrolysis*. By hydrolysis we refer to the chemical combination with water H_2O, by which process the substance is reduced to a simpler form. The change which takes place may be indicated by the formula $C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6$, cane sugar + water = glucose + fructose. The more complex substance, cane sugar, is thus changed to simple sugars, which can be readily absorbed by the body.

Starch has the formula $(C_6H_{10}O_5)n$, and can also be

partially hydrolized by heating with water; but the action is more rapid when acid is present. We usually eat the starch when only partially hydrolized and depend upon the digestive juices of the mouth and small intestine to complete the process. We can indicate the changes that take place by the formula $(C_6H_{10}O_5)n + nH_2O = nC_6H_{12}O_6$.

Starch + water = glucose.

Cellulose has the same formula $(C_6H_{10}O_5)n$. We recognize it in such things as cotton, hemp, wood, paper and the woody fibre of plants. It is insoluble in water and can be digested only very slightly by the human body. It can be softened by heat and that is why vegetables and cereals need cooking, to soften the cellulose which encloses the starch grains and permit them to swell so that they are made digestible. We will see the application of these facts in our cookery lessons.

Fats and oils are also composed of carbon, hydrogen and oxygen, and are formed by the chemical combination of a fatty acid with glycerine. The formula is too complex for you to understand; but we will apply this knowledge later in making soap.

Nitrogen. When we studied about oxygen, you will remember we spoke of the early Chinese discovery that air contained two components—an active element which we have proved to be oxygen, and an inactive one which prevents the oxygen from combining with everything in the world and burning it up. This inactive element is called *nitrogen*. This element is so inert that, though it is mixed with oxygen in the air, it does not combine with it.

Experiment 75. Take a vessel (chatti) of water and have a dry glass tumbler ready at hand. Light a piece of paper twisted to float on the water. Light the paper with a match and, while the paper is burning, hold the tumbler over it. Can you explain the chemical action taking place while the paper burns? Why does it stop burning? What are the white cloudy fumes which you see in the glass? Continue

to hold the glass over the paper until the white fumes have been dissolved into the water. Has the water risen in the glass? How far? I wonder what the gas is that is left in the tumbler?

When the paper burns, we know it is uniting with the oxygen of the air. It stops when all the oxygen in the glass is used up. The fumes are carbon dioxide. When these are dissolved in the water there is still something left in the glass, for the water only rises about one-fifth of the way up. This must be the other element of the air which we have spoken of. Let us see how it acts and then we can name it.

Experiment 76. Take a lighted splinter of wood and carefully lift the glass from the water without turning it over. Insert the lighted stick into the gas in the glass. The flame goes out at once. Try it again. Now try the same test with a glass containing ordinary air.

The gas which remained in the jar is *nitrogen* and we know it will *not* support combustion. Write the characteristic properties of nitrogen in your note-book. It is transparent and odourless, colourless and tasteless. We saw that the water rose only one-fifth of the way in the glass. The other four-fifths was nitrogen. This is about the proportion of nitrogen to oxygen in the air.

Look at the table showing the composition of our foods at the end of this chapter. You will see that the *proteins* contain not only carbon, hydrogen and oxygen, but nitrogen also. This is a very important fact which I wish you to remember please, as it will help you to understand these foods when we discuss the diet and cookery.

The outline tells you that the proteins are necessary for the growth of our bodies. Indeed every living thing requires nitrogen for its development. You might think, with so much nitrogen in the air, we could all have as much of it as we could wish. Unfortunately, *we cannot* take the nitro-

gen from the air as we do the oxygen. What, then, can we do to secure this precious element, without which we would die?

The plants take the nitrogen from the soil, but soon the soil would be exhausted if there were not some way of replenishing it. You will be interested to know that the *pulse* plants—dhal, tur, mug, chauli, etc., have means of drawing the nitrogen from the air and are able to make it into compounds which we call proteins. Then we eat the pulse dhal and secure the nitrogen for our bodies. But how can these plants do this, you may wonder? Other plants cannot do so.

If you pull up one of the *legumes*, or pulse plants, you will find small masses called *tubercles* on its roots. If you break one open and crush it so as to examine it under a powerful microscope, you will find thousands of *bacteria* growing in it. These bacteria have the marvellous power of fixing the nitrogen of the air and combining it with other elements that make good food for the plant.

The plant has not the power to take the nitrogen from the air, it is the bacteria which do the work and the pulses only furnish them the place to live while they do the work. Do you remember when we studied about the bacteria we learned that some of them were our friends? Now you have found one kind of friendly bacteria.

All decaying plants, leaves and manure should be returned to the soil in order to replenish it with the nitrogen which they contain. If the mali burns the leaves, or we burn the manure cakes, the nitrogen escapes into the air, but when they are buried in the earth, the nitrogen can return to the soil. Soil that has lost its nitrogen is not fit to grow other important foods, such as wheat, bajri and jowar.

When the animal and vegetable materials which we use as foods are chemically analysed, we discover that they are composed of the same elements which make up our

bodies. Before we can use these *elements* in our bodies they must be built up into *compounds*, that is, large molecules that are composed of a number of elements. This work of building up the compounds is done by plants, with the help of a substance known as chlorophyll which, with the energy of the sun's rays, gives the plant the power of combining the carbon dioxide of the air with the water and nitrates of the soil. By this means the plants build up

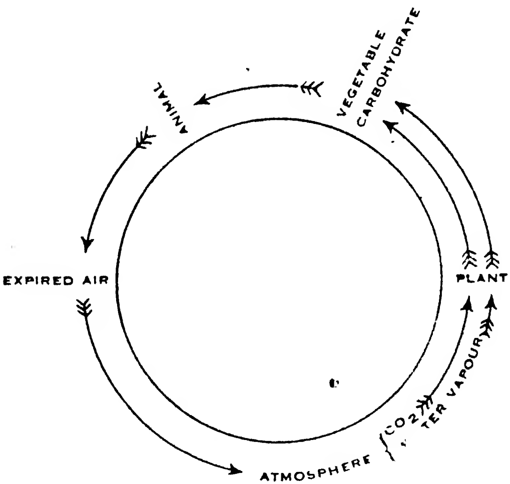

Fig. 120
Carbon food cycle
(From *Food and Dietetics*, by Dr. R. Hutchison. Wm. Wood & Co., New York.)

carbon, hydrogen and oxygen into *carbohydrates* and *fats* and, with the addition of nitrogen, into *proteins* which can be used by animals and man for food. These cycles of changes are illustrated in the accompanying diagrams. Figs. 120 and 121.

The *protein* foodstuffs are complex compounds containing carbon, hydrogen, oxygen and nitrogen. It is not necessary for you to know their chemical formulæ; but you should

understand that their molecules are composed of lesser units. The protein molecule can be *hydrolized* into these simple units called amino acids. Sulphur and phosphorus are present also with the nitrogen in proteins. We will

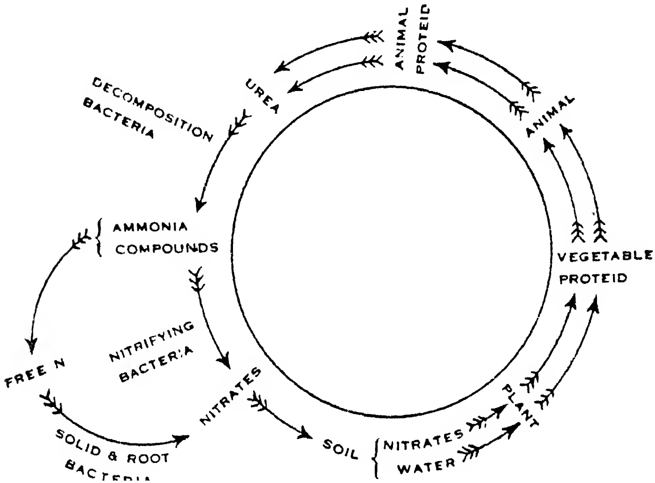

Fig. 121

Nitrogen food cycle

(From *Food and Dietetics*, by Dr. R. Hutchison. Wm. Wood & Co., New York.)

learn more about the proteins in the next chapter and they will again be discussed in connexion with our cookery lessons.

FOOD COMPOSITION, USES AND REQUIREMENTS

Elements Composing Our Food	*Form in Which They Occur*	*Daily Amount Required by an ADULT*	*The USE Our Bodies Make of Them*
1. Hydrogen (H) 2. Oxygen (O)	*Water*	3 seers	Body regulator, carrying food to the tissues and waste away from them
1. Hydrogen (H) 2. Oxygen (O) 3. Carbon (C)	*Carbohydrates* (*a*) Sugars, starches (*b*) Cellulose	67% of diet 360 to 450 grams	(*a*) Gives heat and energy measured by calories (*b*) Roughage
1. Hydrogen (H) 2. Oxygen (O) 3. Carbon (C)	*Fats* and *oils* and sometimes organic acids	17% of diet 80 to 90 grams	Gives heat and energy measured by calories
1. Hydrogen H. 2. Oxygen O. 3. Carbon C. 4. Nitrogen N. (Principally)	*Proteins*. Built up from amino acids by plants and animals	10 to 15% of diet 90 to 100 grams	(1) Builds body tissues for growth and repair (2) Also gives heat and energy measured by calories
5. Sulphur S. 6. Iron Fe. (Small amounts) 7. Phosphorus P. (Occasionally) 8. Calcium Ca. 9. Potassium K. 10. Sodium Na. 11. Chlorine Cl. 12. Iodine I.	*Ash*. Constituents partly as mineral salts and partly in combination with carbohydrates, fats, proteins and other organic compounds	·67 (CaO) 1·32 (P_2O_5) ·015 (Fe.)	Body regulators, and also important for body structure
Vitamins	A, B, C, D, E	Daily supply required, as they cannot be stored by the body	Regulate metabolism, promote growth and reproduction. Protect from deficiency diseases

AGENDA

Oral and Practical Work

1. What are the forms of matter?
2. Of what are substances composed?
3. How large are molecules?
4. What is mass?
5. Explain why matter can change its shape.
6. What kind of a change takes place when you melt wax or heat water?
7. What is a chemical change?
8. What are atoms?
9. What happens when you burn sugar?
10. What is chemistry?
11. What is an element?
12. Classify the following elements as metals and non-metals— iron, bromine, sulphur, phosphorus, potassium, gold, sodium, copper, magnesium, carbon (charcoal), calcium, iodine, zinc.
13. What are the symbols for the above elements?
14. What is a compound?
15. What are the characteristics of oxygen?
16. How much of air and water are composed of oxygen?
17. How can you prove that oxygen *supports* combustion?
18. How do you test for carbon dioxide?
19. Will it support combustion?
20. What lesson does this teach us about the need of fresh air in our homes?
21. Why does iron rust?
22. What are the products of combustion as proved by the candle experiments?
23. What are the characteristics of all acids, as to taste and composition?
24. What are the characteristics of hydrogen?
25. What are bases?
26. What happens when litmus paper is placed in an acid; a base?
27. What happens when an acid and a base are combined?
28. What is formed?
29. How do we apply that principle of neutralization in treating cases of poison? In cooking?
30. What are the properties of carbon?
31. What happens when any organic substance is burned in the air?
32. Why doesn't the oxygen of the air burn everything up?

33. What are the characteristic properties of nitrogen ?
34. What class of foods contain this element ?
35. How do the plants secure the nitrogen ?
36. How can nitrogen be returned to the soil ?

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CHAPTER XI

FOOD AND NUTRITION

'All that a man hath will he give for his life.'

Required.—Milk, potato, rice, bottle or churn, evaporating dish, chatti, segri, scales.

THE accompanying diagram (Fig. 122) is intended to show graphically the materials of which our bodies are composed. You will notice at once what a large quantity of water there is in the body, amounting to about two-thirds of its weight. Protein forms approximately one-fifth of the body weight, while the minerals and fat make up most of the remainder. It is surprising how little carbohydrate is found in the body, considering what a large amount of starch and sugar we eat. Can you tell what becomes of it, in the light of what you have just learned of oxidization?

We learn from this diagram that materials, similar to those of which the body is composed, are necessary to build up the body tissues and repair them. There must be maintained a constant balance between the in-take of food and the out-go of waste products.

We have studied about the digestion of foods and the changes which take place in the cells of the body. The digested food products are brought by the blood to the cells, where a constant *breaking down* and *building up* of material in the cells take place. These changes are known scientifically as *metabolism*. We might liken the breaking down, or *katabolism*, to Siva, the Destroyer; the *anabolism*, or building up, to Brahma, the Creator; and the whole process of *metabolism* to Vishnu, the Maintainer. It is

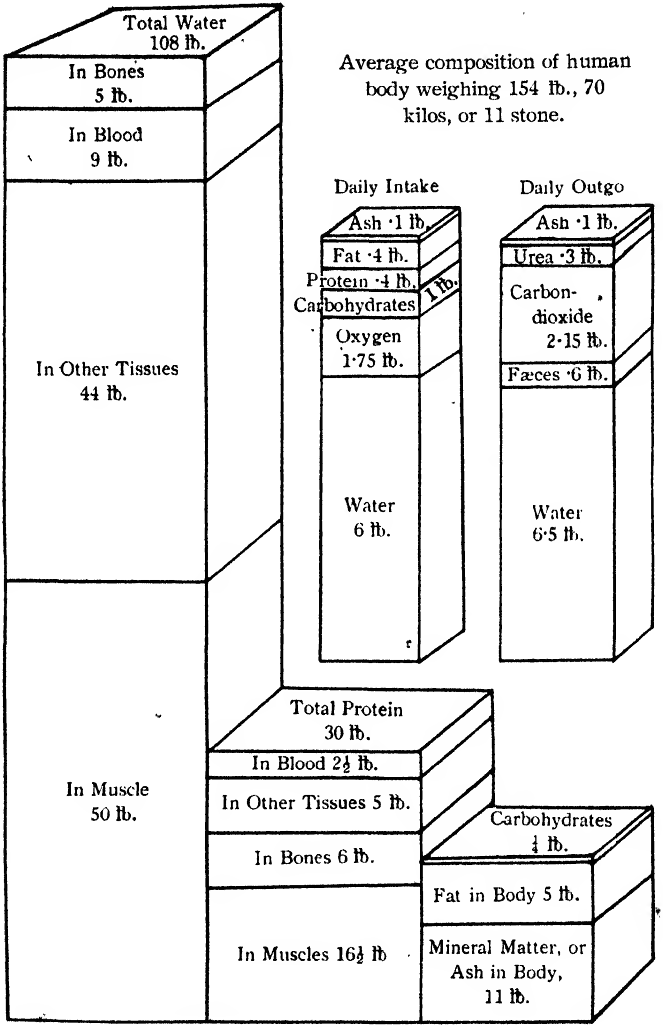

Fig. 122

Vitamins are necessary to build these materials into human form

like the Christian death and resurrection for eternal life, through constant change and evolution.

Every living creature must have food to keep it alive. Food is needed to provide heat and energy, to build body tissue and to regulate the processes of the body. Human beings of different races do not take their foods in the same form and people of the same race have very strong individual preferences. Generally speaking, each race has selected from the foods available those which have been found by experience to nourish them and then these foods become their customary diet. We form habits of taking food prepared in a certain way and these habits become traditionally so strong that we hold a great distaste for taking them in a different way. The food customs of people are among the strongest prejudices in their lives and, in time, these habits come to be rooted in their religion, so that they would even die rather than break with tradition.

But if a little child of one race is taken and brought up by people of another race, he enjoys the foods of his adopted family and his body adjusts itself to the different diet quite readily. Children form their likes and dislikes for foods very early in life and hang on to them tenaciously. It is, therefore, very important that they form the *right food habits.*

How is it possible that the body can use such diverse foods and that diets, seemingly so different, are capable of nourishing the body? Foods must be more alike than their appearance and taste would indicate. Would you like to understand about the composition of the foods we eat and their relation to our bodies? What is food?

A *food* is a substance which, when taken into the body, may be digested and used to *give heat* and *energy*, to *build body tissues* and to *regulate body processes.*

Some foodstuffs are able to do more than one of these things. *Carbohydrates*, *fats* and *proteins* are all used for

body fuel, to give heat and energy; but *proteins also* build body tissues. The mineral salts are used not only to build body tissues, but *also* to assist in regulating body processes. Of course, most foods are not pure protein, fat or carbohydrate, but mixtures of these. Some foods contain only one kind of food substance, others may contain two or more. Corn starch and white sugar are examples of foods which are pure carbohydrates and, therefore, can *only* furnish heat and energy.

Let us consider *milk* as an example of those foods which contain *all* the food substances (Fig. 123). You are so

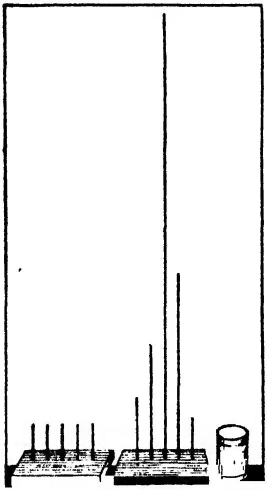

Fig. 123

Contributions to the diet made by a glass of milk. Compare with a standard portion of an adequate diet.

	'*Shares' in Standard Portion of Adequate Diet* (*Left*)	'*Shares' in One Glass of Milk* (*Right*)
Calorie shares[1]	1·0	1·6
Protein shares	1·0	3·0
Calcium shares	1·0	12·1
Phosphorus shares	1·0	4·9
Iron shares	1·0	1·1

[1] Read shares from left to right.

(From *Foundations of Nutrition*, by Dr. M. S. Rose. The Macmillan Co., New York.)

familiar with milk, it will be easy for you to understand its approximate composition.

Experiment 77. (1) *Fat:* If you let milk stand a few hours, what do you observe rises to the top? What is *cream*? The fat in cream is in small globules and they rise to the top of the fluid. We skim this off and churn it to make

butter. When you heat butter and clarify it to make *ghee*, you have separated out the pure *fat* of the milk.

(2) *Protein:* If the milk thickens in standing, you are able to make solid *curds* from it. The liquid which separates is known as *whey*. The curd of the milk is its chief *protein*. Some people make cheese from curds.

(3) *Water:* In the whey there is a large amount of *water*.

(4) *Sugar:* If you should evaporate the whey by boiling, you would secure more solids containing the *carbohydrate of milk*, called *milk-sugar*. You are acquainted with the process of making mawa by evaporating milk, and realize that milk is sweeter when concentrated this way. Try making some mawa. First weigh the milk before you begin to heat it. Weigh the mawa when done and estimate how much water has been lost.

(5) *Mineral salts:* If you continue to heat the mawa in a crucible, it will burn up and leave an *ash*. The ash of the milk contains the *mineral matter*.

(6) *Vitamins:* Milk contains also some very important substances known as *vitamins*.

You cannot see the vitamins in the food; but when foods which do not contain vitamins are fed to animals they are unable to grow and soon develop diseases.

Most foods are neither entirely composed of *one* food substance like corn starch and sugar, nor yet contain *all* of them as milk does. They may contain two or more food substances, but *one* is likely to predominate. Therefore we group the foods under headings, classifying them according to the substance of which each contains the largest amount. The following list is a good one to study with a view to understand the different *classes* of foods. In a *well-balanced* diet we need to choose some food from each group every day. If you wish, you can think of each group as a 'caste', with many families of foods under each. Only you must not imagine one food caste superior to another. *All* classes are essential to health.

The Food Groups

(See how often the same food is found in the various groups.)

I. *Body building material: Proteins*

Sources:

Animal: milk, eggs, meat, fish, fowl.

Vegetable: pulses, grams, dhals, wheat, bajri, nuts, leafy vegetable.

II. *Body regulators: Mineral salts*

Calcium. Sources:

Animal: milk, buttermilk, curds, whey, egg yolk.

Vegetable: dhals, nuts, fruits, gram, leafy vegetables.

Phosphorus. Sources:

Animal: milk and buttermilk, eggs, meat, fish.

Vegetable: beans, lentils, nuts, wheat, oats, barley, leafy and succulent vegetable, spinach, radish, cucumber, carrot, cauliflower.

Iron. Sources:

Animal: liver, red meats, eggs.

Vegetable: dhal, whole cereals, leafy and succulent vegetables and fruits.

Iodine. Sources:

Animal: sea fish and oils.

Vegetable: seaweed, fruits and green leafy vegetables.

III. *Body builders:*

Vitamin A. Sources:

Animal: fats and oils from fish, liver, kidney, egg yolk, butter and ghee, whole milk.

Vegetable: green leafy vegetables and vegetable tops, bamboo sprouts, lucerne, gram, sprouted grain, yellow root vegetables as carrots and sweet potato, tomato and bajri.

Vitamin B. Sources:

Animal: eggs, liver, brain, heart, kidney.

Vegetable: yeast, tomato, lettuce, spinach and leafy vegetables, walnuts, atta, bajri, dhal, milk.

Vitamin C. Sources:

Animal: liver, blood, milk.

Vegetable: green, leafy, fresh vegetables, fresh fruits, sprouted grains and dhal, raw carrot, orange juice and peel.

Vitamin D. Sources:

Animal: cod liver oil, milk, butter, ghee, egg yolk, fish.

Vegetable: sea plants, vegetables grown in sunlight, oils and grains.

Vitamin E. Sources: whole wheat, vegetables.

IV. *Fuel foods* (providing heat and energy to the body):

Fats. Sources:

Animal: butter, ghee, cream and milk, fish oils, dripping.

Vegetable: vegetable oils, til, olive, ground nuts, etc.

Carbohodrates:

Sugars: in fruits, jaggery, gul, treacle, white and brown sugar, honey.

Starches: in cereal grains, dhals, beans, nuts, tuber and root vegetables, bananas.

Cellulose (or roughage): the woody fibre found in vegetables and fruits.

Carbohydrates and *fats* are used for *heat* and *energy.* When you wish to build a fire to secure heat for cooking your dinner, you may use different fuels. Some ignite more readily than others, so we use dried grass or paper, then bits of wood and on this we place charcoal or coal and so secure a hot fire. The oxygen of the air combines with the

carbon of the fuel, giving off carbon dioxide and water and releasing heat. We know that oil and ghee will burn and so will sugar or dhal.

Scientists have proved by experiment that the *foods we eat* are oxidized in the body, giving off *carbon dioxide* and *water* and releasing *heat* which the body may use to keep itself warm, or convert into energy for work. The heart must beat constantly and this requires as much energy as to lift four maunds weight into the air 2,500 feet. The digestion of our food calls for energy and everything we do, from yawning to grinding, calls for energy. The food we eat supplies the fuel for this work. Our body makes use of different kinds of fuel. Carbohydrates, fats and proteins may all be oxidized in the body to give heat and energy.

Carbohydrates. To this group belong *sugars*, in the form of *cane*, *jaggery*, *gul*, *shakkar*, *honey*, *dates* and *figs*, which are quick fuels. *Sago*, *casava*, *potato*, *corn*, *banana* and *rice* give us fuel in another form which we call *starch*. Both sugar and starch belong to the same family and all are named *carbohydrates*.

Fats. *Butter* and *ghee* from animal sources; *nuts*, *til*, *sesame* and *other vegetable oils* belong to the family of *fats*. The carbohydrates and fats are our *chief* sources of fuel.

Proteins. *Tur*, *gram*, *mug*, *chauli*, *wal*, *almonds*, *walnuts*, *pistachio*, *groundnuts*, and *corn* such as *wheat*, *bajri* and *jowar* contain starch; and *curds*, *eggs*, *fish* and *meat* also contain fat; but all are classed as *protein foods* because of their high protein contents. Proteins *may be burned* for fuel, but their chief work is to build body tissue. You would not use wood or coal to make or mend your stove, but would secure some material more suitable, such as clay or metal. So the proteins are *building materials* and their work is to *build the body tissues.* You may, however, build your house, using grass or wood and the left

over bits may be burned; so proteins build body tissue and any excess may also be burned for heat and energy.

Scientists have been able to determine the *amount* of heat which each food will furnish the body and indicate the quantity in terms of *calories*. Do you know how the quantity of heat is measured?

When we measure it in the form of *light*, we call it 'candle power'. *Electricity* is measured in 'kilowatt hours'; *work* is measured as 'foot-pounds', that is, the amount of energy required to lift one pound weight one foot into the air; and *heat* is measured in *calories*.

A great calorie is the amount of heat required to raise a kilogram of water 1° Centigrade, or a pound of water 4° Fahrenheit.

(*Note.* In measuring the heat values of foods, we use the *large calorie* which is 1,000 times greater than the one used in Physics.)

You cannot *see* a calorie; it is just a unit of measurement, as the inch is a unit for measuring length, and the pound, or seer, is a unit of weight. The great calorie is used by scientists in nutrition for measuring the *amount* of *heat* which a food will furnish. They also use the *gram* as the *unit* of *weight* for foods. There are 28·35 grams in one oz., and 453·6 grams in one pound. There are 11·7 grams in one tola, and 468 grams in one seer.

If we eat a gram (masa) of sugar or starch, it will furnish 4 calories of heat to the body; a gram of oil or pure fat, 9 calories; a gram of pure protein, 4 calories.

It is customary to state the quantities of food in 100 calorie portions. Would you like to see how much food is required to yield 100 calories of heat?

Exercise 8. Take your balances, and gram or ounce weights. Measure out 100 calorie portions of some common foods and record the quantities, both by weight and measure, in your note-books, in this form.

100 CALORIE PORTIONS

Approximate weight and measure of the 100 calorie portions of each of the common grain products as ordinarily purchased

Food	Calories	Weight			Measure	Cost
		Grams (masa)	Ounces	Tolas	Spoonfuls or cupfuls	Per pound or seer
Bajri	100	28	1	$2\frac{1}{2}$	3 Table-spoonfuls	?

Method of using balances. Balance the scale by means of a small balance wheel until the pointer swings as far to the left as to the right and, when at rest, is in the centre. To remove the weights from the box, grasp them by the handles only. Replace the weights in the box as soon as you have finished weighing.

The articles to be weighed should be placed on the left side of the scales, the weights on the right. If, in weighing soft goods, pieces of paper of equal weight be placed on either side of the scales, the scales will not have to be readjusted. When a plate or cup is used for holding any food, place one of corresponding size on the side with the weights and only slight adjustment will be necessary.

Exercise 9. Find the weight of the cup, chatti and plate in the kitchen. Record these weights in your note-book and it will save you time when you come to weigh foods in these vessels.

Weigh out 28·35 grams of atta. How many ounces have you? Measure the quantity with a tablespoon.

Weigh one cup of sugar. How many grams, or tolas, are in one cup of sugar? How many ounces? What proportion of a pound, or seer, is it?

Exercise 10. (1) Measure 100 calorie portions of wheat, atta, maida, soji, rice.

(2) Measure 100 calorie portions of wal, tur, mug, chauli, gram.

(3) „ 100 „ „ „ vegetables and fruits.

Note.—See p. 253 for list of 100 calorie portions. Where food

values are stated in percentages, note the column which gives the *number of grams* (masas) of the food required to furnish 100 calories. With this information you can calculate the composition of each food portion eaten.

From the 100 calorie portions you can select the amount which you eat in a day, also the amount used by your family. Calculate the number of calories you and your family eat and see if it approximates the standard.

Table of comparative weights: Metric, English and *Indian.* It will be noted that the Indian table of weights very closely approximates the metric system; so closely, indeed, that for all practical purposes you can consider:

1 gunja	=	1 decigram
1 masa	=	1 gram

If you work on this basis, you should find the weights easy:

2½ tolas	=	1 ounce
40 tolas	=	1 seer
16 ounces	=	1 ,, or pound

This is not absolutely exact, but, as we take the tola to equal the weight of one rupee, this is approximately true.

1 tola	=	11·7 grams
1 seer	=	468·0 grams which very nearly approaches the number of grams in a pound weight
1 oz.	=	28·35 grams
1 lb.	=	453·6 ,,

Working this out, we find our tables quite easy.

Table of weights used in this text

8 gunjas	=	1	masa, approximately 1 gram
12 masas	=	1	tola
40 tolas	=	1	seer or pound (lb.)
40 seers	=	1	kaccha maund
1 ounce	=	2½	tolas, or 30 masas
16 ounces	=	1	lb. or seer
14 lb.	=	1	stone

APPROXIMATE EQUIVALENTS

Sugar	Gunj	M. gm.	Mas.	Gm.	Tsp.	Tola	Oz.	Tbsp.	Seer	Lb.	10 oz. C.	20 oz. Pt.	40 oz. Qt.	Maund
Equivalents of														
1 gunj ...	1	1	$\frac{1}{8}$	$\frac{1}{11}$	$\frac{1}{32}$	$\frac{1}{96}$	...	...	...	...	...	...	...	...
1 masa ...	8	...	1	1	$\frac{1}{4}$	$\frac{1}{12}$	$\frac{1}{30}$	...	...	...	...	...	...	...
1 tola ...	...	...	12	11·7	3	1	$\frac{2}{5}$	1	$\frac{1}{40}$	...	...	...	...	...
1 oz. ...	...	...	30	28·35	...	$2\frac{1}{2}$	1	$2\frac{1}{2}$	...	$\frac{1}{16}$	...	...	...	...
1 cup ...	...	...	...	234	...	20	8	20	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	...	...
1 seer ...	...	...	...	468	...	40	16	40	1	1	...	...	...	$\frac{1}{40}$
1 pint ...	...	...	...	...	...	50	20	...	...	...	2	1	$\frac{1}{2}$	...

Protein foods provide body building materials. Protein is necessary to every cell of our bodies. This is because it contains nitrogen which other foods do not. Nitrogen is the element of prime importance in the upkeep of the cells and for growth.

Proteins are built up from the *amino acids*, of which there are eighteen. Just as different combinations of letters make different words, until we have a dictionary full ; so the different combinations of amino acids build up many, many proteins, as different as words are from each other. Some of the amino acids are especially important and unless they are included in the structure of the protein food it is incapable of sustaining growth. Such proteins are called *incomplete.*

If you had eighteen shades of coloured cotton yarn, you could weave them into many bright patterns. In some you might use all of the colours, in others only a few. The patterns which contained the eighteen colours we would call 'complete'. You might, however, take one pattern which was incomplete, perhaps containing no shades of blue and combine it with another pattern in which blue predominated, thus making the colours 'complete'.

In like manner, we may eat a protein food, like that contained in wheat, which is lacking in certain amino acids and which is, therefore, 'incomplete', and combine it with milk which contains the very amino acids lacking in wheat, thus completing it. No living creature can *grow* without 'complete' proteins and therefore children or animals fed on *incomplete proteins* cannot grow (Fig. 124).

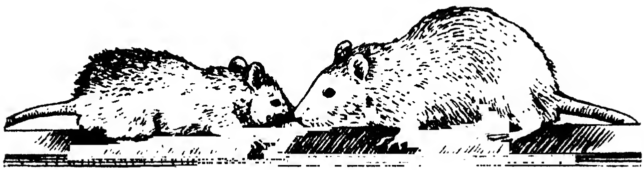

Fig. 124

The little rat was fed upon atta (whole wheatmeal) and cream. The large rat had some whole milk with his atta. Why did he grow bigger than his brother ?

(Nutrition Laboratory, Battle Creek Sanatorium, Michigan, U.S.A.)

From a study made by the author and her students of household arts, at Baroda in 1920, it was shown that the protein in the average diet was low in quantity as well as quality. This is due to the limited sources of protein among Hindu people, many of whom do not use eggs, fish or meat and whose supply of milk is meagre.

On the other hand, it is surprising how the body has been able to adapt itself to the food supply in different countries. The Eskimos are not able to secure carbohydrates and so must burn fats and proteins for body fuel. The Eskimo uses 44 per cent protein as compared with the Hindu's 9 per cent and the European's 16 per cent. While the Eskimo can use protein for fuel, the Hindu *cannot* use carbohydrate for building body tissue. The low amount of protein in the Hindu diet is a menace to his race.

From the following list of food compositions classified as 'body building materials', you will notice that the protein

PERCENTAGE COMPOSITION OF SOME PROTEIN FOODS—'BODY BUILDING MATERIALS'

	Protein %	Fat %	Carbo-hydrate %	Fuel value per lb. calories	100 calorie portion grams
Bajri (millet) ...	11·68	5·5	74·68	1635	28
Beef (lean) ...	18·9	12·2	...	842	54
Bread (whole wheat) (roti) ...	9·7	·9	49·7	1113	41
Curds (dhati) ...	20·9	1·0	4·3	499	91
Cheese (panir) ...	28·8	35·9	·3	1990	23
Chicken (murghi) ...	21·5	2·5	...	493	92
Eggs (ande) ...	13·4	10·5	...	672	68
Fish (masa) ...	18·8	9·5	...	727	61
Flour (maida) ...	13·8	1·9	71·9	1630	28
Liver ...	20·4	4·5	1·7	583	78
Lobster (shevand) ...	16·4	1·8	·4	379	120
Milk (dudh) (cows' milk) ...	3·6	5·7	4·7	380	120
Mutton (gosh) ...	19·8	12·4	...	863	52
Oysters ...	6·2	1·2	3·7	228	199
Mungphali (groundnuts) ...	25·8	38·6	24·4	2490	18
Tur (dhal) ...	22·89	1·35	69·31	1610	38
Wal (dried) ...	22·4	1·4	54·2	1347	34

From this list you can calculate the amount of milk, etc., required to replace the dhal.

foods from *animal sources* are milk, curds, cheese, eggs and meats (fish, fowl, animals). These furnish 'complete' proteins. It is reasonable that many people do not want to kill in order to satisfy their need for food. Therefore we must consider how the protein may be otherwise supplied.

Vegetable proteins are found in our great *variety* of dhals (pulses or legumes). The amount of protein in these vegetables is very high; but they lack certain amino acids and are therefore classed as 'incomplete'. Let us plan the diet so as to supply the parts that are lacking by adding some food which contains 'complete' protein. Instead of relying upon wheat, or wheat, rice and dhal alone, for the protein, we will add milk curds or eggs. Green leaf vegetables also contain complete protein, though the quantity is small. These will, therefore, supplement the cereals and

pulses and provide materials for growth. To leave out some of the amino acids would be like trying to make a scone or chapatti without any liquid. The flour would not form a dough. Or it would be as if you tried to make a garment without any thread to sew it with. You cannot build a house without the building materials and neither can you build the human body without all the amino acids in the protein.

How much protein do we require?

From 75 to 100 grams of protein are required daily to provide the necessary building material for the growth and

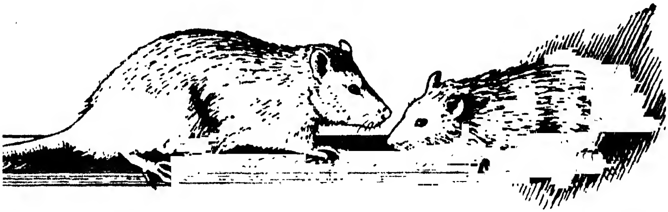

Fig. 125

The big rat had adequate protein in his diet; the little one had not

(Nutrition Laboratory, Battle Creek Sanitorium, Michigan, U.S.A.)

repair of our tissues. Can you calculate the weight of each food required to furnish this amount of protein? One way of figuring this out is by determining the *percentage* of protein in the diet. Protein should not furnish less than 12 per cent of the calories and it is considered better to provide 15 per cent of protein in the diet for growing children (Figs. 125 and 126).

Mineral salts or ash constituents are 'body regulators' and furnish body building material. If you read Chapter I, p. 17, Fig. 12, you will realize that the cells of the body are like the individual people of our country; and that, as we are governed by laws, so the conduct of the cells must be regulated that they may work together harmoni-

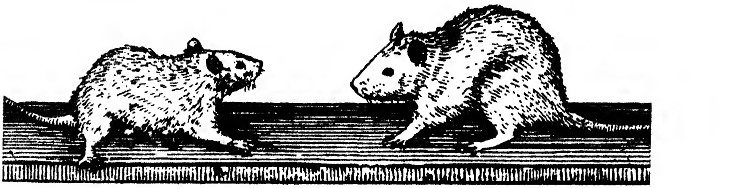

Fig. 126

The effect on growth of a diet in which the protein is of good quality but insufficient in amount. The diet of the rat on the left contained half as much casein as that of the one on the right. In other respects the two diets were practically alike. Both rats are the same age, 112 days.

(From *The Foundations of Nutrition*, by Dr. Mary Swartz Rose. The Macmillan Co., New York.)

ously. The regulating of body cells is done by the *ash* (or *mineral*) constituents, by the *water* and by the *vitamins*. These substances are called *body regulators*. What minerals are contained in our bodies? Which are most abundant? Why are they necessary in our diet?

We have learned that a baby doubles his weight in six months and trebles it in one year. Between two and six years his body weight is nearly doubled again. His height increases about three inches each year, or twelve inches in the four years from two to six. His skull becomes as large in circumference as it will ever be and his brain grows proportionately, reaching almost adult weight.

His body structure forms into true bone and the bones elongate. His jaw-bone develops to make room for twenty-four teeth. His heart grows four times its weight and the muscles grow strong. It is important that the nervous system be protected and provided with adequate food. The bones and teeth must be supplied with material for growth and the heart must be protected from overstrain.

Poor teeth and crooked legs hollow chests and poorly developed lungs are largely the result of an insufficient supply of *ash constituents*, particularly *calcium* (chuna, or

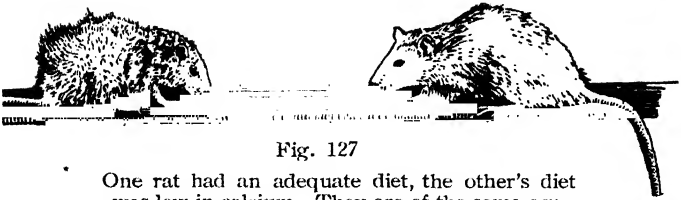

Fig. 127

One rat had an adequate diet, the other's diet was low in calcium. They are of the same age.
(Nutrition Laboratory, Battle Creek Sanitorium, Michigan, U.S.A.)

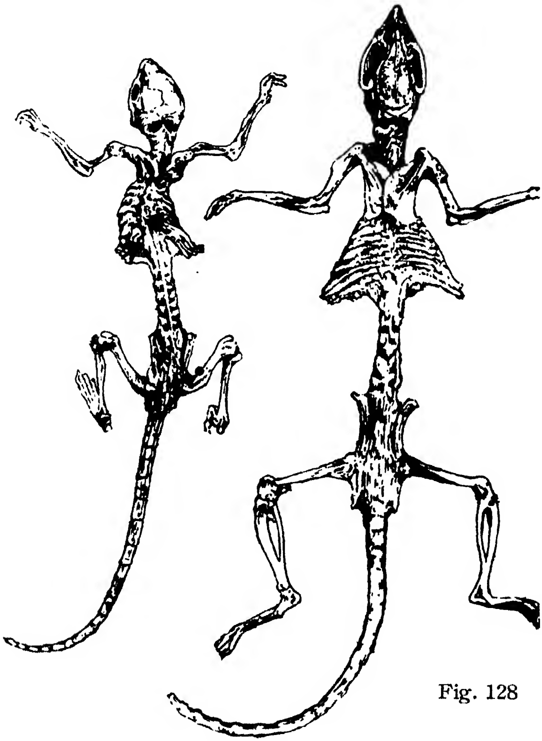

Fig. 128

Skeletons of rats having adequate and inadequate calcium in their diet. Note bowed legs, curved spine, rachitic ribs, deformed pelvic girdle, poor teeth

(Nutrition Laboratory, Battle Creek Sanitorium, Michigan, U.S.A.)

lime) and *phosphorus*. *Sulphur* and *iron* are always combined with protein in our food materials. *Phosphorus* and *calcium* are sometimes so combined; but we also get them in other forms. Phosphorus is found combined with fat, in *egg yolk* (yellow of egg). *Iron* is found in the yolk also, as well as in hæmoglobin of blood and in the *green* leaves of *plants* and outer coat of *grains*. Milk furnishes a rich supply of *calcium* (chuna), *phosphorus* and some *iron* (Figs. 127 and 128).

Iron, as we have learned, is an essential element of the red corpuscles, enabling them to carry oxygen. If the body

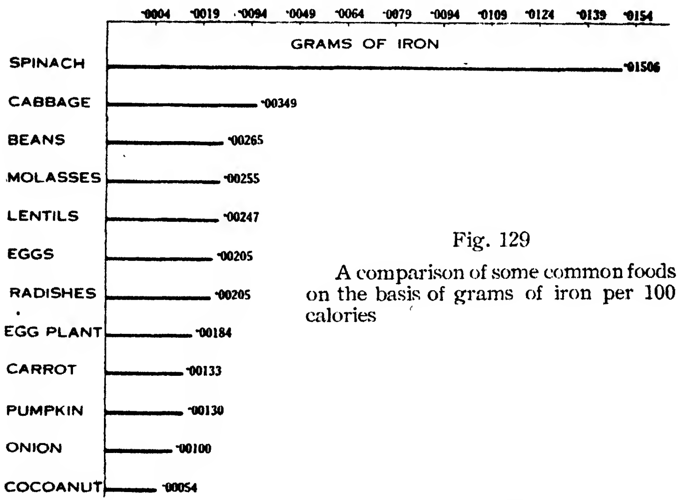

Fig. 129

A comparison of some common foods on the basis of grams of iron per 100 calories

lacks iron, it must work twice as hard to purify the blood and this may injure the heart by overtaxing it. Every cell of the body requires iron as an integral part of its nucleus, so that our very life depends upon our supply of iron. A baby is born with a store of iron to last him for six months. After that, foods containing iron and vitamins need to be added to the milk, or he will become anæmic.

Green vegetables (Fig. 129), spinach, poi, alu, chowla, methi, ambadi and yellow turnips contain *iron*. These may

be crushed or ground to extract the *juice*, by squeezing them in a cloth and given to an infant or invalid. Later the vegetables may be slightly cooked and put through a sieve and given to the baby in very tiny quantities, as he grows older. Dhal of peas and other pulses are rich in iron. When thoroughly cooked, it may be *sifted* and fed to the child, after he is weaned.

Egg yolk is rich in iron and phosphorus. This may be added to the milk raw in small quantities, or cooked until dry and then sifted and eaten with other food.

Soji and atta contain iron. They may be cooked thoroughly by boiling in water for a *long time*, and added to the milk. As he grows older he can eat the soji alone or cooked with *milk*.

Liver is rich in iron also.

A plentiful supply of *green* vegetables and fruits will be required to keep up the supply of iron for an *adult* who does not eat eggs or meat. Dr. Sherman considers fifteen milligrams the daily amount required for health. Everyone should endeavour to include some of these foods every day in his diet as long as he lives, if he would be healthy.

Calcium. From the outline giving the elementary composition of our bodies, you will see that sulphur, phosphorus, chlorine, sodium, potassium, calcium, iron and iodine form the chief ash constituents or mineral matter of our bodies. These are necessary for the growth and repair of the body and are essential for regulating the body functions.

You have already learned that the bony framework of the body is built up by means of calcium and phosphorus. Calcium or lime (chuna) is necessary to form the bones and teeth, but our power to deposit the calcium in the bones is dependent upon the phosphorus, so we must be sure that both of these elements are liberally supplied.

It appears from the author's study of diets in Baroda,

that the calcium content is low. Let us consider what the effect of this will be upon our health. Calcium is not only important for the bones of our limbs, but also for those of the thorax and pelvis. If we have not enough lime, the spine and thorax may become crooked and our lungs will be compressed so that we are unable to breathe properly. Can you explain what the effect of this would be upon the blood? If the pelvis is not properly developed, can you explain the effect this would have upon child-bearing?

Calcium is also necessary to give us power to contract our muscles. Refer back to Chapter IV, and see if you understand the meaning of contractility of muscles. If the muscles of the heart do not contract as they should, you will understand the effect it would have upon the beating of the heart.

Calcium also affects our nervous tissue, and during the early years, when the child's nervous system is developing rapidly and the brain growing fast, you can appreciate how important it is that calcium should be liberally supplied.

Calcium is also necessary for the coagulation of the blood. When you cut your finger, the blood flows freely at first and then forms a clot. This clotting of the blood is due to the calcium in it. It also helps to maintain the neutrality of the blood. You can understand how much better we shall be if we have plenty of calcium in our food and water.

Mothers require a generous amount of calcium during pregnancy and the time of nursing the baby, for they must supply the calcium to develop the baby's skeleton and supply it with material for growth. Teeth require calcium and, as teeth are formed in the gums before the baby is born, the mother must provide calcium for this purpose also. She will need *one gram* of calcium per day and this can be supplied by *two seers of milk*. We find that milk is one of the best foods for the body needs and this is the best form in which children can take the calcium. Green

leafy vegetables also are rich in calcium and adults secure most of their supply in this form, but they also would be better for adding milk to the diet (Fig. 130).

Phosphorus. The ash constituents are important for many other body processes. Phosphorus helps to keep the blood neutral and helps in the oxidization of the carbohydrates. It also plays a part in the multiplication and movement of the cells. It is estimated that we require 1·32 grams of phosphorus per day and children should not have less than one gram per day.

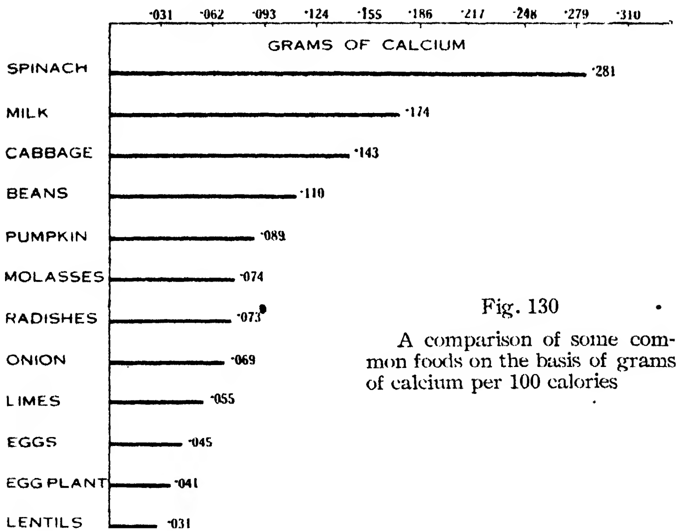

Fig. 130

A comparison of some common foods on the basis of grams of calcium per 100 calories

Without phosphorus, as we have already noted, the calcium cannot be deposited in the bones and the result is a disease named *rickets.* We must have these two minerals in proper proportion in the diet to prevent rickets. *Sunshine* is a very important factor in preventing rickets and we in India have a generous supply of this. Little children who run freely in the sunshine unclothed are safeguarded from this disease. Girls and women, who maintain *purdah* and do

not enjoy the sunshine, are in danger of this disease which affects the bony structure of the body, especially the development of the pelvis, making the bearing of the young dangerous. Have you ever seen anyone with rickets? Such children usually have protuberant abdomens, narrow chests, bow-legs or knock-knees and are apt to have troubles such as bronchitis, pneumonia and tuberculosis. Later we will learn that there is another factor (see Vitamins) concerned with the prevention and cure of rickets.

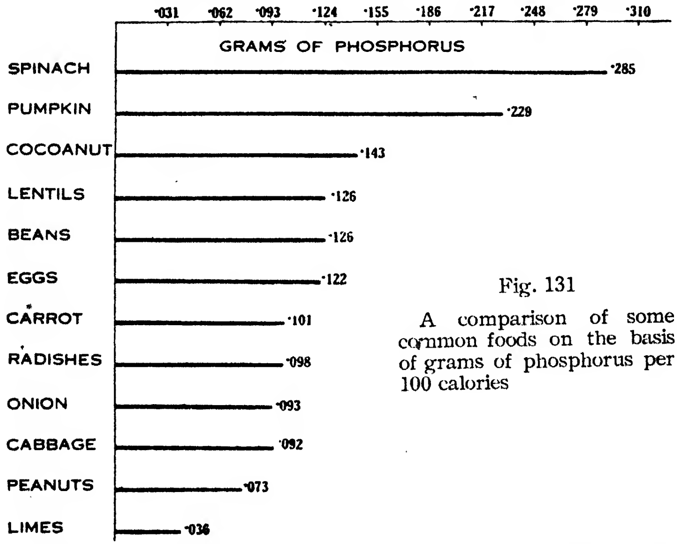

Fig. 131

A comparison of some common foods on the basis of grams of phosphorus per 100 calories

The foods which are rich in phosphorus are spinach and similar green vegetables, butter-milk, fish, curds, legumes or dhal, and egg-yolk (Fig. 131).

Calcium, *phosphorus* and *iron* are the three most important ash constituents for us to know about, as they are most apt to be deficient in the diet. If we have sufficient protein in our diet, we will be getting the necessary amount of *sulphur*. *Potassium* is furnished abundantly in our vegetables, dhal or legumes, wheat and milk. It is also

found in meat and eggs. *Chlorine* and *sodium* are provided by table salt and there is no danger of our not having sufficient of these minerals.

Why do we add it to our vegetables? Because our vegetables have not enough *sodium* in their composition to balance the *potassium* they contain. Meat contains a plentiful amount of sodium and, therefore, animals that live on meat do not need to eat any salt. People who use a mixed diet require a little salt; but they must be careful not to take too much or they will injure their arteries and kidneys. Salt is an important factor in keeping the blood of the right composition and the organs acting as they should. Sodium helps to retain water in the tissues, and chlorine assists in forming the hydrochloric acid for the digestive juices of the stomach.

Another mineral essential to normal nutrition, though we require only a small quantity, is *iodine*. Some people in India suffer from a disease known as *goitre* and it has been generally accepted that this is the result of the lack of iodine in the body. Iodine is found in *crude salt*, such as we ordinarily use in India, before it is purified. It will be a great pity if the time comes when the salt is not used in this natural condition, for then we shall suffer from another deficiency which modern civilization has brought upon us. Iodine is found in sea water and the crude salt retains some of this element. Sea foods, such as *fish* and *fish oils*, also provide iodine; *leafy vegetables* and *fruits*, grown in the soil which contains iodine, will also furnish iodine in the diet. Without this ash constituent, tiny though the quantity needed may be, goitre will become more extensive. This disease is characterized by the swelling of the thyroid gland and other symptoms even more distressing. The necessity for an adequate diet of *green vegetables*, *fruits* and *milk* is thus further supported by our wish to prevent goitre.

Water. From Fig. 122 on p. 230 we learn that a large proportion of our bodies is made up of water and this pro-

portion must be maintained. If we have not sufficient water, the metabolism of our bodies is interfered with and the various functions are upset. We lose our appetites, become nervous, have indigestion and are unable to do our work. Water is necessary to carry off the body wastes and to regulate the body temperature. As we have previously learned, we should make the drinking of water one of our health habits. We not only take it as a beverage, but also as a part of our food. Some foods are nearly all water. Lettuce, tomatoes, green vegetables and fresh fruits have over 90 per cent in their composition. We realize that oranges are watery, because the juice is easily released, but you may be surprised to know that potatoes, carrots and such seemingly solid foods have about as much water in them as oranges, that is, over 80 per cent. Even such hard foods as groundnuts contain 10 per cent water. When we cook our legumes or pulses (dhal), and seed grains (atta, etc.), we add water to them and in this way render them more easily digested. We also take water in such beverages as sherbat, tea and milk. Pure water is as essential to health as food. Many waters have minerals held in solution, but the point of greatest importance is that it be *clean* and *safe*.

The vitamins, or *body builders*. The food substances, such as carbohydrates, fats, proteins, ash and water can all be seen and examined. For many years it was thought that these were all that the body required to maintain health and growth. But, by experiments in feeding animals, it was found that if these foodstuffs were purified so that nothing but *pure* carbohydrate, fat, protein, ash and water were taken by the animal, it was *unable to grow*. Something was lacking.

Professor Hopkins, of Cambridge University, began feeding young white rats with a diet of pure protein, purified fat, purified starch, pure sugar and mineral salts. The rats were

NUMBER OF GRAMS (OR MASAS) OF MINERAL CONSTITUENTS IN 100 CALORIES OF EACH FOOD LISTED

Name of food	Calcium	Phosphorus	Iron
Almonds (badam) ...	·037	·072	·00060
Apples	·012	·020	·00048
Banana	·009	·031	·00061
Beans (guar)	·110	·126	·00265
Butter (muska)	·002	·002	·00003
Cabbage, raw	·143	·092	·00349
Chappati (bread)	·011	·035	·00035
Carrot (gajra)	·124	·101	·00133
Cauliflower (fulaver) ...	·403	·200	·00197
Celery	·421	·201	·00270
Cheese (curds)	·212	·156	·00030
Cocoanut (ola-naral) ...	·028	·143	·00054
Cream (malayi)	·050	·044	.00010
Cucumber (kakadi)	·090	·191	·00115
Eggplant (brinjal)	·041	·122	·00184
Egg	·045	·122	·00205
Egg white...	·020	·022	·00020
Egg yolk	·036	·118	·00230
White flour (maida) ...	·006	·026	·00023
Entire wheat flour	·009	·066	·00070
Lemons	·081	·049	·00135
Lentils (dhal)	·031	·126	·00247
Marrow (dudhi)	·224	·224	·00785
Milk (dudh)	·174	·134	·00035
Molasses (rab)	·074	·015	·00255
Onion (kanda)	·069	·093	·00100
Oranges	·088	·040	·00039
Peanuts (mung)	·013	·073	·00036
Peas (tuar)	·026	·120	·00165
Pine-apple, fresh	·041	·064	·00116
Potato, white	·016	·069	·00156
Sweet potato (ratala) ...	·016	·037	·00041
Pumpkins (bhopala) ...	·089	·229	·00130
Peas (chauli)	·029	·132	...
Radishes (mula)	·073	·098	·00205
Rice, unpolished	·003	·060	·00058
Rice, polished	·001	·027	·00026
Rutabaga (Swedish turnip) ...	·185	·140	...
Semolina (soji)	·006	·035	·00022
Spinach (poi)	·281	·285	·01506
Tomato (tamate)	·050	·113	·00175
Walnuts (akharot)	·013	·015	·00030
Warrow (dutlic)	·039	·035	·0013

unable to grow and their health speedily declined. When a little cows' milk was added to the diet, the rats began immediately to grow. Thus Professor Hopkins became convinced that there was something else in the milk besides protein, fat, carbohydrate, ash and water, previously unknown.

At the same time, other scientific men in America were also experimenting with the feeding of animals. Doctors Osborne and Mendal discovered that the substance required for growth was found in the *fat* of milk or butter. Doctors McCallum and Davis proved that there is something in *butter fat* and *egg yolk*, *not* found in lard and vegetable fats, which is essential for growth and health. We now know that substance as *vitamin A*.

Since that time scientific men and women have continued the feeding experiments, and many important discoveries have been made as to the nature of vitamins, the effect upon animals and people when the vitamins are *wanting* in the diet and where they may be found.

You will be interested in knowing why white rats are used for the feeding experiments. A rat's life is not so long as that of larger animals and man; in fact, one day to a rat is equal to one month in the life of man; and one year of man is the same as *thirty years* to a rat. A rat likes all the food which we eat and he does not mind living in a small space. So it is easy to note the effect of different diets upon the rat and to determine whether it is a good diet or a poor one. It is possible also to tell the effects upon the children and grandchildren of the rats. In this way, many important discoveries have been made, proving that the vitamins are *essential to health*, to *growth* and to *prevention of disease.* Several vitamins have been discovered and *all* of them are *essential for growth.* The diet may contain everything else, but if it lacks any one of the vitamins the animal cannot grow. As soon as food containing the vitamin is added, the

animal begins at once to grow. We can judge from this the effect upon children of not having vitamins in their food.

Vitamin A. In addition to being necessary for growth, it has been found that, when this vitamin is absent from the diet of animals and children, a *disease of the eyes is produced.* The disease is known as kerophthalmia (Fig. 132). It is very painful and causes the eyes to swell and close. If vitamin A is not given at once the eyes become permanently *blind* and death may also occur. A Japanese, named Mori, observed many human cases of this disease and found

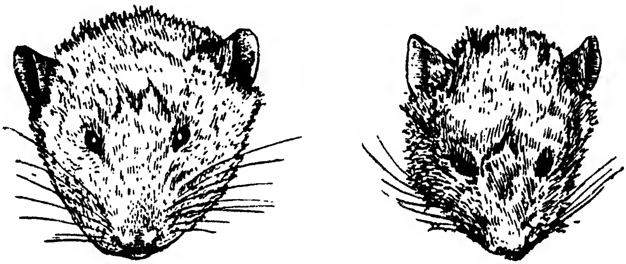

Fig. 132

One rat had an adequate diet, the other's diet lacked vitamin A. Note the result of this deficiency is kerophthalmia, as shown by eyes.
(Nutrition Laboratory, Battle Creek Sanitorium, Michigan, U.S.A.)

they were curable by feeding chicken livers, fish livers, eel fat and cod liver oil to the patients.

If people sell the cream and butter from the milk and feed the children on skimmed milk, this dreadful eye disease will result. This has been proved in Denmark. India should learn from this example that it is unwise to allow butter factories to ship the milk fats away.

During the War the children in Europe suffered from eye troubles, because there was so little butter or whole milk and other foods containing vitamin A. Wise doctors went to their help and gave them cod liver oil which cured them.

The lack of vitamin A makes one much more susceptible

to other diseases, such as bronchial pneumonia and lung trouble.

It has been proved that rats with a liberal supply of vitamin A live more than twice as long as those which had exactly the same diet, excepting less vitamin A. It has been shown also that the rats with sufficient vitamin A for health and growth are successful in rearing their young to several generations; while the young of those with too little vitamin A do not live. Where are we to get vitamin A, to keep us well and make us grow?

As you have seen, butter, fat, ghee, egg yolk, cod liver oil are rich in vitamin A. *Cod liver oil* can be purchased from the chemist and given to little children who are too young to eat green leaf vegetables. It contains three times as much vitamin A as does egg yolk and ten times as much as butter or ghee contains—therefore only a little need be given. This is a good thing to give babies who cannot have their mothers' milk, but must be artificially fed. In some Indian villages it is a well-known practice to give chicken livers to those suffering from eye disease. The glandular organs of animals contain vitamin A.

Heating the food of animal origin at a high temperature in an open vessel will destroy much of the vitamin and that explains why, when ghee is used in frying, the vitamin A is destroyed.

Vitamin A is to be found in the green leaves of vegetables. It is also in the growing stems or shoots and sprouts of plants. Cabbage, spinach, poi, alu, chowla, methi, ambadi, patri, tandulja, pudina, kottimber, bhendi and the green pods of mogery, tuar, wal, guar, bamboo tops and chauli are foods of the class that contain vitamin A.

Though they are naturally found in these green vegetables, you may lose or destroy the vitamins and lose the minerals by the way in which you prepare and cook them. The custom among some is to squeeze the methi and throw

away the rich green juice extracted. You say the juice gives a strong taste. Remember the juice also will make strong boys and girls, so do not throw it away. You must not over-cook the vegetables, for if you cook them a long time you will destroy the vitamins. Eating vegetables raw, as salad or koshimbeer, is the best way to retain the nutriments of the vegetable, not only the vitamin but the mineral ash.

The germs of seeds and *sprouted* grains are rich in vitamin A, and both carrots (gajra) and sweet potato (ratala and sakarkand) contain some of this vitamin.

Fig. 133

These foods are rich in vitamin A (the growth promoting and anti-keropthalmic vitamin): ghee, cream, butter, egg yolk, carrots, sweet potato, spinach and the *whole* grains.

10 Orange juice contains more vitamin A than sweet lime and this contains more than sour lime. Tomato juice is richer in vitamin A than orange juice (Fig. 133).

Vegetable oils are lacking in this vitamin. Sesame oil (til oil) is therefore not to be depended upon to supply vitamin A, though it is an excellent source of fuel (calories). If vegetable oils are used, then you must be sure to have plenty of *green leaf vegetables*, *milk* and *eggs* in your diet.

The oil much used to-day and advocated by doctors and dietitians as a rich source of vitamin A is cod liver oil. It is ten times as rich in vitamin A as butter and may be given to the children as a means of promoting growth and preventing *rickets*.

Vitamin B. When vitamin B is absent from our food, the *appetite* is lost. *Indigestion* follows the failure to *absorb* the food. The intestines lose their ability to resist disease and so bacteria infect the alimentary tract. It has also been shown that the *organs* of the body degenerate and vitality is lowered. The person weakens and becomes ill as a result. Not only are the heart, liver, kidneys and thyroid affected, but the ovaries and testes lose their power to function and, therefore, reproduction is impossible.

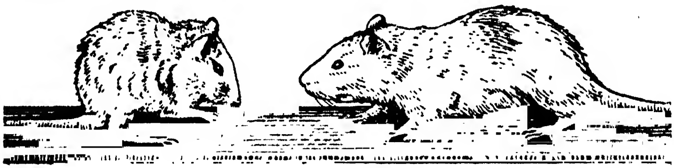

Fig. 134

These two rats are the same age (8 weeks). The one on the right has had an adequate diet, the one on the left a diet lacking vitamin B.

(From *Foundations of Nutrition*, by Dr. Mary Swartz Rose. The Macmillan Co., New York.)

The first discoveries relating to this vitamin were made by Eijkman, experimenting with fowls, feeding them on *polished rice*. The vitamin is found in the *polishings*, which we give to the cow. That is very good for the cow, but is very bad for the children. The picture illustrates how lack of vitamin B affects rats (Fig. 134). Now we have proved that similarly children *cannot grow* when vitamin B is lacking in the food. Indeed, if they had every other food substance but lacked this vitamin only, they would lose appetite, sicken and die.

Beri-beri is a disease which affects the nerves of motion

and sensation. This disease is caused by lack of vitamin B. Seeing what dreadful conditions result from the want of vitamin B, you will be eager to know where it is to be found. It is found in *unpolished rice*, *bran* and also in the outer coatings and embryo of other grains (wheat, bajri). If you use unrefined food grains, you will not lack vitamin B. Remember that the refined white flour (maida) has lost its vitamins and also its mineral salts in the milling. Therefore use *atta*. Dried peas and beans and dhal contain this vitamin. Seeds contain five times as much vitamin B as milk or

Fig. 135

These foods are rich in vitamin B (the growth-promoting and anti-neuritic vitamin): milk, eggs, beans, yeast, potatoes, celery, nuts, onions, apples; glandular organs, liver, heart, brains.

tomato juice, and egg yolk has three times as much. Spinach contains twice as much as potato, turnip, carrot, onions, and fruits contain still less. Yeast is rich in this vitamin and so are the organs of animals—liver, kidney, heart and brains, also nuts of all kinds (Fig. 135).

If we eat the entire seed grains and unpolished rice and dhal, and take plenty of vegetables and milk in our food, we will not want for vitamin B. If we are careless cooks we shall destroy the vitamin. Wash the rice as little as possible and never forget that *long*-continued cooking and

soda will destroy vitamins. Try to prepare food quickly. Do not throw away the water in which vegetables are cooked, for half the vitamins are in the water. *Never* use soda to cook vegetables.

Dr. Robert McCarrison,[1] of the British Medical Service in India, has made extensive experiments upon the effects of a diet lacking in vitamin B and you should secure his reports and study them.

Vitamin C. Scurvy is a disease that has been known for many centuries. Practical experience in many countries proved that people who had only *dried* foods were liable to contract scurvy. The real cause is of recent discovery. Experience has shown that fresh oranges, lemons, tomatoes, sprouted seeds and pulses, green leaf vegetables and tubers would cure scurvy. Now we know this is due to the presence of vitamin C.

Sailors on long voyages and soldiers often die in large numbers from this dreadful disease which causes loss of weight, tender swollen joints and paralysis. Their *teeth* loosen and soften and they feel lazy and tired. They ache as with rheumatism.

But it is not only soldiers and sailors who suffer ill effects from lack of vitamin C in the diet. Infants who are fed on heated milk lose their appetite, become anæmic, irritable and weak, and fail to grow. Teeth will fail to develop properly and will decay early.

Instead of giving medicine or opium, the child should be given food containing vitamin C. In New Zealand the Swedish turnip juice is given to infants who must be artificially fed. In America tomato juice is used and the juice of the *orange* is advocated when people can afford to use oranges. The *white* part of the *orange rind* also is rich in

[1] These facts are verified in *Foundations of Nutrition*, by Dr. M. S. Rose; also in *Food*, by Dr. Robert McCarrison (Macmillan & Co., Ltd.).

vitamin C. This is an economical source of vitamins and will use all of the fruit. Scrape out the white part of the rind, pound or grind it, and soak it in water. Bring it to the boil and cook only a minute; cool, strain and give the water to the child in small doses. Throw away the pulp. Fresh raw cabbage, spinach and sprouted pulses are rich in this vitamin (Fig. 136).

Since we must heat the milk in India to preserve and purify it, we should know the best way, so that the vitamins may not be destroyed. As we have seen, long slow cooking

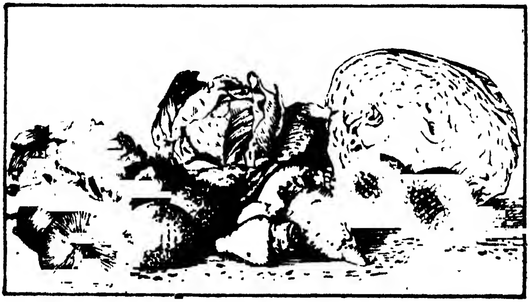

Fig. 136

These foods are rich in vitamin C (the anti-scorbutic vitamin): cabbage, lemons, lettuce, water-cress, tomatoes, turnips.

is destructive of vitamins, therefore *bring it rapidly to the boiling point; let it boil two minutes and then set the vessel in cold water and cool the milk rapidly.*

Babies that are bottle-fed should also be given the juice of some vegetable containing vitamin C, and breast-fed babies also should have it after they are six months old. A teaspoonful of orange or tomato or carrot *juice* would safeguard the baby. The amount of vitamin C in cows' milk depends upon the amount of green food the cow herself has had to eat. Also the mother must eat green leaf vegetables and vitamin-bearing food, or her milk will not

provide for the needs of the child. This is another reason, therefore, for properly feeding ourselves and our cattle.

We should remember that it is the *growing* part of the plant, the *active* leaf and germ, and the juicy *fresh* vegetables which possess vitamin C. Sprouted seeds are rich in it. Remember also that cooking, drying and ageing destroys the vitamin. Fresh koshimbeers or salads should form a part of our daily food. Do *not* use soda in cooking vegetables. If you must cook them, do so quickly and *reserve the juices* to be served with the vegetable or in the soup. Do not use too much water, but rather steam the vegetables in their own juices.

Animal foods do not contain nearly so much of vitamin C as do vegetables. Eggs and flesh of animals contain none. Vegetarians are, therefore, less apt to have scurvy than meat eaters and this may also in part account for the fact that Indians have such good teeth.

Vitamin D. Each year scientists are making further discoveries regarding the vitamins in foods and the effect upon human beings and animals when they are wanting in our diets. They are such very important factors that we must give them our special attention. Unless we know where they are found, we may ignorantly leave them out of our food in sufficient quantities to maintain health and growth. And it is especially necessary for us to realize the effect of heat upon them, that we may not destroy them by our method of cooking. Vitamin D is also found in the *green* vegetable foods. Cod liver oil, egg yolk, butter and milk are the chief sources of this vitamin (Fig. 137).

Vitamin D is important in preventing in children the disease known as *rickets*. Do you remember where we have spoken of this disease before? Would you recognize the symptoms of rickets? The bones soften and bend, causing bow-legs, the breast bone is deformed and the abdomen is distended. The muscles relax and the child is

restless and weak. Constipation is very apt to cause trouble and the blood lacks red corpuscles. His teeth are bad and he is subject to colds which may end in pneumonia.

If mothers are careful to eat fresh green vegetables (not fried), butter or ghee instead of til, drink milk and eat eggs, their babies will be born strong and will have sound bones

Fig. 137
These foods are rich in vitamin D (anti-rachitic vitamin): apples, corn, yeast, grapes.

and good teeth. Their breast milk will be rich in vitamins for the baby. *Cod liver oil* is an excellent thing to take if these foods are lacking.

Rickets are also cured with the aid of *sunshine.* This we can all enjoy in profusion in our sunny land, if we will. The old custom of *purdah* should be abandoned, for women and babies especially need to go out into the fresh air and sunshine. Have you forgotten the necessity of having the pelvis develop well if we are to bear our children safely? Vitamin D and sunshine are necessary for this. Then, when our baby is born, let us see that he has a daily *sun* bath and give him a little cod liver oil and vegetable juice. This is the best way we can serve our native land, by bearing and bringing up healthy, strong, happy children.

Vitamin E. This is the vitamin especially concerned

with *reproduction.* Without it the germ cells die, the young do not develop and the people are sterile. This vitamin is found in the wheat germ (oil), in the fat of milk (cream), and in green leaves of plants.

New discoveries are constantly being made by scientists along the line of vitamins and their function in growth and health. If you read the papers and magazines, you may be able to keep up with these discoveries.

Exercise 11. Determine the composition of milk:

1. (*a*) By separating the fat and churning it to make butter.

(*b*) By preparing curds from the whey.

(*c*) By evaporating the milk and noting its change in weight when water is removed.

(*d*) By drying the evaporated milk and observing the ash.

2. Weigh a potato and set it aside to dry. Compare its weight when dried with its original weight and note how much water was evaporated.

3. Cook a tola of rice and measure carefully the amount of water added. Weigh when cooked and note how much the rice has absorbed.

4. Calculate the amount of milk required to supply:

(*a*) the amount of protein you need;

(*b*) the amount of calories you need.

5. Classify all the foods you use and see if you are adequately supplied with all you need for health and growth.

AGENDA

Oral and Practical Work

1. What is food?
2. How may foods be classified?
3. What is the composition of milk?
4. What foods are used for body fuel, to provide it with heat and energy?
5. What foods are used for repair and growth of body tissue?
6. What foods are necessary for regulating the body processes?
7. What is the effect of too little calcium in the diet? What is the best way to supply it?
8. Why do we require phosphorus for health and growth?

9. What use is iron in the system?

10. What proof have we of the effect of having insufficient vitamins in our food?

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CHAPTER XII

FOOD MATERIALS

'By food the living live; food comes of rain,
And rain comes by the pious sacrifice,
And sacrifice is paid with tithes of toil;
Thus action is of Brahma, who is One.'
—*Sir Edwin Arnold.*

Required.—Maida, atta, bread, potatoes, egg, milk, nitric acid, iodine, ammonium hydroxide, scales and weights, test tubes, mulmul, chatti, oven, microscope.

WHEN we speak of a vegetarian diet in India, we include all foods of vegetable origin; but it is well to classify our foods more carefully according to their composition and food value.

The seeds and pods of plants which are commonly dried and stored for food may be classed as *food grains.* These should be considered under three headings:

1. *Cereal* grains, in which the *carbohydrates* predominate. We must, however, remember that wheat, bajri, jowar, nagli, vari and kodra contain a fair proportion of *protein*, as you can prove by experiment. Rice and maize also belong to this group.

2. *Pulse* grains are rich in *protein* and proportionately less so in *carbohydrate.* When the pulse grain is split, we call them dhals, and these furnish the main source of nitrogen in a vegetarian's diet. Tur, udid, gavar, matki, kulith and gram, masur, soy bean are commonly used.

3. *Oil* seeds are grains whose most prominent characteristic is oil. Among these may be classed nuts, such as

magfati, or groundnut (peanut); coconut, cotton seed, til or sesame seed; sunflower seed; castor seed.

Rice is the chief staple of half the people in the world and is used in all countries that have hot or temperate climates. It is the basis of diet for some peoples in India. *Maize*, too, is used commonly by people in tropical or semi-tropical countries. Africa, Italy, America and India all use this cereal, but not so commonly as wheat and bajri.

Wheat, however, is the staple of the *world* and forms the common bread of all nations. In India we eat all of these and also have other less well-known cereals which are excellent for bread and highly nutritious, bajri, jowar and kodra being extensively used.

The charts (Figs. 138 to 142) illustrate the composition of these grains and the table of food analysis gives accurate information of the proportion of each foodstuff which they contain. You can also test for the starch and protein in the grains.

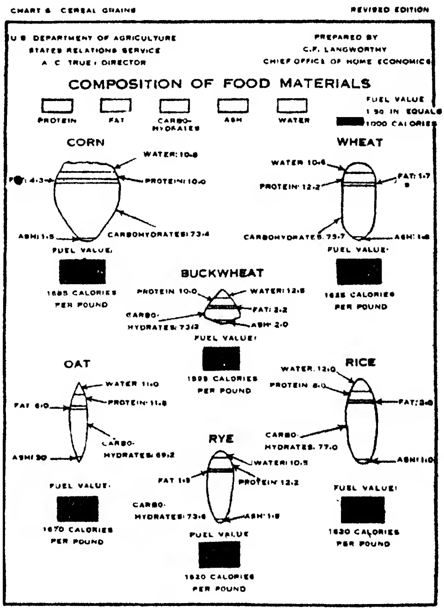


Fig. 138

The *diagram* (Fig. 143) of a grain of wheat illustrates its structure. The bran layer is composed chiefly of cellulose and

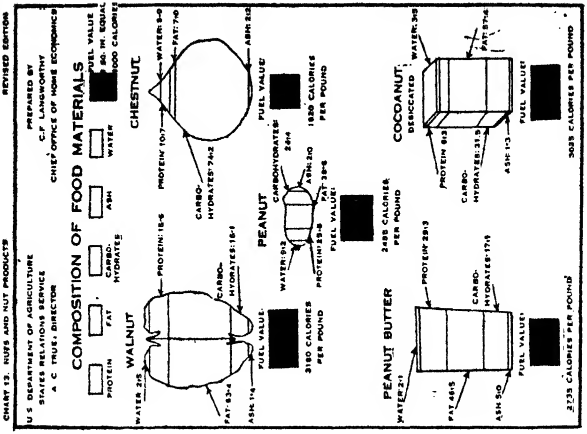


Fig 140

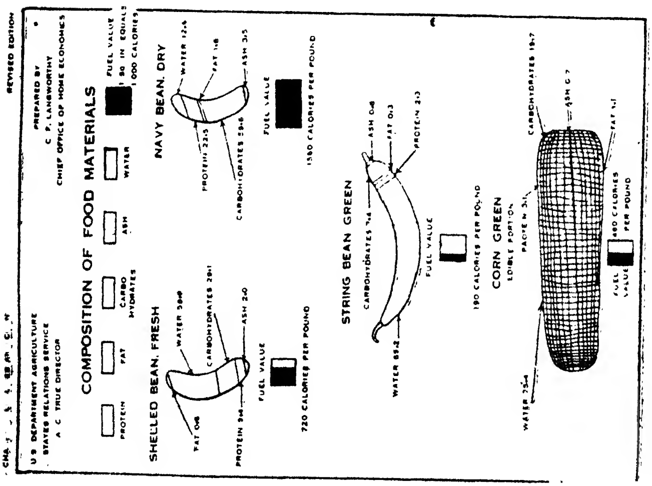


Fig. 139

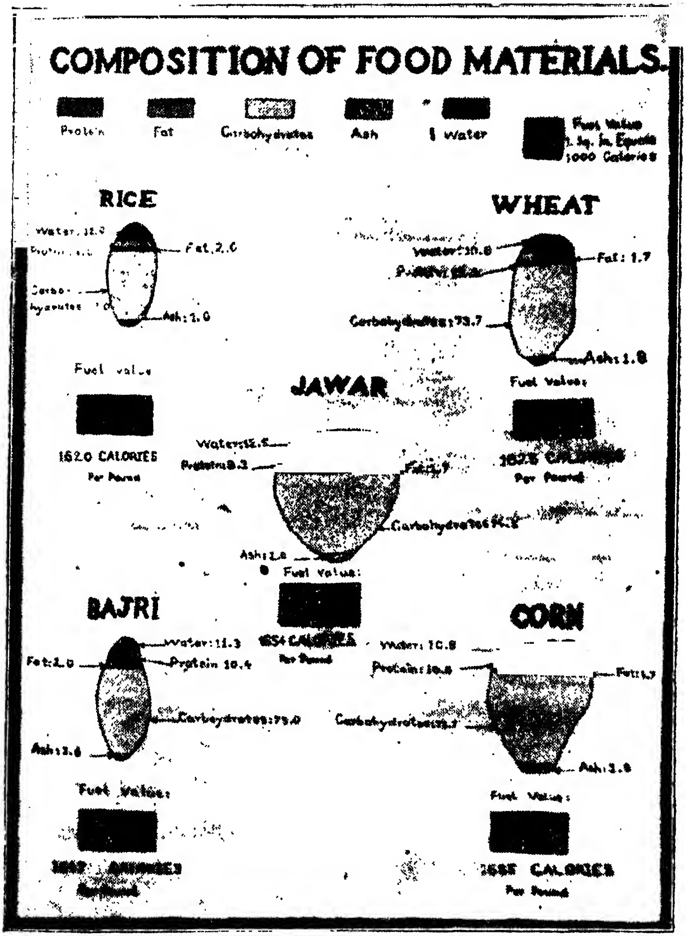


Fig. 141

Indian cereals

(Prepared by Maharani Girls' High School, in Baroda.)

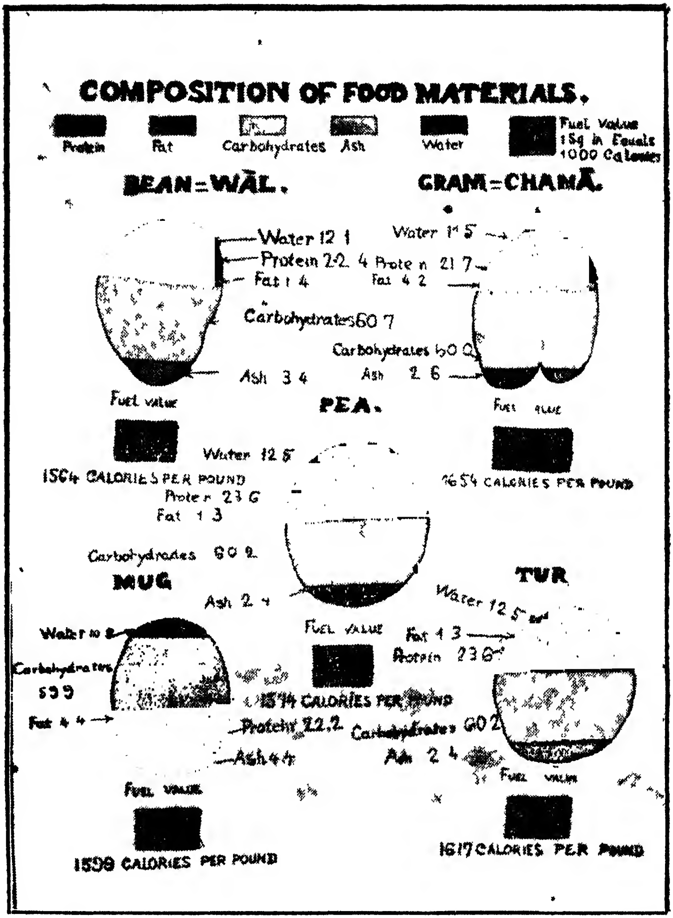


Fig 142

Indian pulses

(Prepared by Maharani Girls High School, in Baroda)

mineral matter. In the patent processes of milling wheat the aleurone layer and the germ are often removed with the outer bran coat. When we grind our wheat between two stones, we retain the aleurone layer and the germ which are rich in protein and phosphorus compounds. White flour contains only the endosperm which is chiefly composed of starch cells. Can you explain why the flour ground at home (atta) is more nutritious than the white milled flour ?

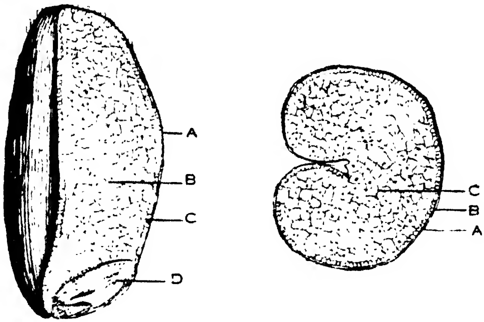


Fig. 143

(From *Food Products*, by Dr. H. C. Sharman. The Macmillan Co., New York.)

Is the white flour (maida) wholly starch ? There is a network of protein in the flour cells and the starch granules are closely interspersed with this. When the protein is moistened and kneaded for bread, the protein becomes fibrous and gummy.

Experiment 78. Take a tola of maida or atta and moisten it with water, as if you were going to make a chapatti or scone. Knead it to make it smooth and let it stand half an hour. Put it in a piece of mulmul or butter-muslin and tie it in the form of a bag. Place it in a chatti of cold water and work it with your fingers. Note the white substance which comes out into the water. Test this for starch. Set the chatti aside for a time to let the starch

settle. Continue to wash the material in the bag until the water is no longer milky and then open the bag.

Examine what was left after washing out the starch. What does it look like? How does it feel? Is it like glue? We call it 'gluten', and it is the substance which holds our bread together. Let us test it.

Experiment 79. Weigh what is left in the bag when the starch is removed. Divide into two parts. Heat one part on a thava or in an oven and note what happens to it. Does it remain soft? What will you say is the effect of heat upon gluten? Gluten is a *protein* and, to prove this, we must know the test for proteins.

Experiment 80. Take a small amount of water in a test tube. Add a little of the gluten and a *few drops* of nitric acid (HNO_3), and boil. A yellow colour appears. Add a *few drops* of ammonium hydroxide ($NH_4(OH)$) and re-heat. The *orange* colour shows that a protein is present.

Experiment 81. Test different foodstuffs for protein — bread, egg, potatoes, cornmeal, etc. Make a table showing together the results.

Let us next examine the milky mixture left in the chatti. What has happened? Pour the water in the chatti carefully off the top and examine the white material left. What is it? This is the *starch* of wheat.

Sometimes it is difficult to detect starch with the naked eye and, therefore, we have found a means of identifying it under a microscope. Starch may also be tested chemically.

Experiment 82. Take a little tincture of iodine in a test tube and dilute with water. What colour is it? Add a few drops of iodine solution to the starch mixture found in the bottom of the chatti and note the change in colour which takes place.

This is the characteristic colour when starch is present. Now try the iodine test on other foods and list those that have starch in them.

Experiment 83. Gently heat the starch mixture which you have tested with iodine and allow it to cool. What happens? Can you explain? Take a small portion of dry starch in a clean, dry test tube and heat it gently. Explain the moisture which condenses on the cooler part of the tube. Increase the heat and note the odour of the vapour and the colour of the starch. What does it suggest? Now heat it until only a black residue remains. What is it?

Experiment 84. Mix a small portion of starch with water and cook it. What does it look like? Dip a small piece of muslin in it; squeeze it and let it dry. What happens to the cloth?

The patent *white* flours (maida) have had the wheat germs and all the bran coatings removed. In this way most of the minerals and vitamins are lost.

In India, we have the great advantage of having our rice husked but *not polished.* The polishing of rice deprives it of both mineral and vitamins. In China and Japan the custom of using polished rice in their diet has shown results in deficiency diseases. When people form the habit of using polished rice, the unpolished rice becomes distasteful to them and they do not realize what a serious effect it will have upon their health. Japan is finding it difficult to make up for the loss in her food supply brought about by the new food habits. Let us learn from their mistakes and not make the same ones ourselves. *Whole* kernels of wheat (atta) and bajri are far superior, both in taste and food value, to the white, devitalized patent flour (maida). And unpolished rice contains not only the starch, but also some of the mineral matter and vitamins that are essential to growth and health.

The proteins of cereals are not 'complete', there being some of the amino acids missing which must be supplied from other sources, such as milk and its products, curds, buttermilk and cheese, or with green leafy vegetables and curds. There is little fat in the cereal grains; we, therefore,

use cream or milk, butter or ghee, or oil from the oil seeds and nuts with our breadstuffs.

Vitamin B is present in cereals and when the whole grain is used there is some vitamin A, but the vitamin C is wanting. This can be supplied from green, leafy vegetables, sprouted gram and milk. Cereals contain very little calcium and this lack must be made good with such foods as are rich in calcium, such as milk and green leafy vegetables.

Cereals do not contain sufficient protein and this must be supplemented with other foods, rich in protein.

The *pulse* grains (dhals), which are rich in protein, are commonly taken with the cereal grains—wheat, rice, bajri, etc.—in most Indian diets.[1] We are not able to assimilate an unlimited amount of dhal and it is wisest to combine the dhal with wheat or rice in no larger proportion than four tolas of dhal to twenty tolas of the cereal grains. It is a still better plan to take only two tolas of dhal and use milk, curds or green leafy vegetables to make up the rest. Wheat and rice and bajri eaters can secure enough carbohydrate food from these sources; but complete protein, fat, calcium, vitamins A, C and D must be supplied by dhal, milk, curds, green vegetables and fruits.

Nuts. A tola of *nuts* will yield 100 calories of heat. They are rich in fat and contain some carbohydrates. The *protein* of nuts is *complete*, being very similar to meat and will sustain growth. Almonds or groundnuts (mugfali) eaten with chapatti made from whole wheat (atta) or *bajri* (ragi) will provide an *adequate diet* of *protein*, *fat* and *carbohydrate*. These nuts are also rich in *phosphorus*, and almonds are especially rich in *iron*. Like the cereals of corn, they contain vitamin B, but very little vitamin A, and no C.

Our custom of grinding nuts and using them in our foods

[1] See Dr. Robert McCarrison, *Food*. (Macmillan & Co., Ltd.)

PERCENTAGE COMPOSITION OF INDIAN FOOD GRAINS

Food	*Water %*	*Protein %*	*Fat %*	*Carbo-hydrates %*	*Fibre %*	*Ash %*	*Total Calories per lb.*	*100 Calorie Portions Grams weight*
Wheat	...	10·99	2·08	70·9	·92	1·45	1571	28·0
Polished rice ...	7·7	6·75	1·05	83·72	·05	·73	1685	26·5
Cleaned rice ...	12·66	6·43	1·77	78·63	·25	·86	1427	30·0
Jowar (larger) ...	12·5	9·3	2·0	72·3	2·2	1·7	1562	28·0
Bajri (small) ...	11·3	10·4	3·3	71·5	1·5	2·0	1621	27·0
Kodra	11·7	7·0	2·1	77·2	·7	1·3	1427	30·8
Maize	12·5	9·5	3·6	72·7	...	1·7	1639	26·0
Nachani ...	13·2	7·3	1·5	75·7	...	2·3	1568	28·0
Rala	10·2	10·8	2·9	74·9	...	1·2	1674	26·4

PERCENTAGE COMPOSITION OF INDIAN PULSE GRAINS

Food	*Water %*	*Protein %*	*Fat %*	*Carbo-hydrates %*	*Fibre %*	*Ash %*	*Total Calories per lb.*	*100 Calorie Portions Grams weight*
Wal	21·1	22·4	1·4	54·2	6·5	3·4	1347	34·0
Pea	12·5	23·6	1·3	54·5	5·7	2·4	1470	31·1
Chauli	12·7	23·1	1·1	55·3	4·2	3·6	1467	31·2
Matki	11·2	23·8	·6	56·6	4·2	3·6	1474	31·0
Guar	11·8	29·8	1·4	46·2	7·7	3·1	1436	31·9
Mug	10·8	22·2	2·7	54·1	5·8	4·4	1494	30·6
Gram	11·5	21·7	4·2	59·0	1·0	2·6	1636	27·9
Tur	10·5	22·3	2·1	60·9	1·2	3·0	1595	28·7
Masur	11·80	25·1	1·3	59·6	...	2·2	1590	28·9

is an excellent one. They are more easily digested when finely ground or chewed. Groundnuts (mugfali) may be pounded and eaten with bread in place of ghee or butter and will be found very appetizing and nutritious. They may be purchased as 'peanut butter'. On fast days the Hindu takes nuts, dates, raisins or figs, made into sweet balls, cooks sago in milk, and prepares buttermilk and bhinda (okra). Such a diet is a completely nutritious one. Can

you tell why? In milk, curds, cheese, eggs, meat, the proteins are *complete*. Vegetable proteins must be combined with one of these to supplement their incomplete proteins. Milk is, therefore, a most important food to combine with the cereals and legumes. From 10 per cent to 12 per cent of the total calories should be in the form of protein. A fasting fakir not only burns his own body tissues for fuel, but also for use of the active cells. That is why he becomes so thin.

The vegetable foods which are eaten fresh and kept without drying may be grouped according to the part of the plant (root, stem, flower, leaf, fruit) which is used for food. A better classification, though not easily defined, is the following:

Starchy vegetables and fruits are those parts of the plant which are storehouses of carbohydrate (starch or sugar), for food for the young plant. The roots and tubers, especially, belong to this class, such as the potato (batate, alu or patela); sweet potato (ratala and sakar kraund), yam (surau and goradu); carrots, parsnips, beets, turnips and artichokes; shungadi (like chestnuts); peas (tuar papdi); butter beans (wal papdi); string beans (gavar papdi); cow peas (chauli papdi); kidney beans (mogary papdi); and would all be placed in this class. Among the fruits we have the plantain and banana, apple, pear, mango, papaya, bread-fruit and coconut.

The *succulent* vegetables are sometimes called the *green* or *watery* vegetables and under this heading we would group the white pumpkin (bhopala, kaddu); red pumpkin (kora, gol-kaddu); the squash or marrow (dudhi); egg plants (ringa, brinjal, vangi); gourd (gilka, giloda); cucumber (kakadi or tandali); cauliflower (fulaver); tomato (tamate); mula (white radish); okra (bhindi); kali (patri); spinach (pol); and other greens, such as alu, ghola, methi, ambadi, tandulja, kottimber, etc.

The *juicy fruits* are—orange, pumelo, sweet lime, sour lime, pine-apple, custard apple, pomegranate.

If you examine the table of food values, you will be able to compare relative composition of these. See also Figs. 144 to 146.

From the table of *ash constituents* you will see the comparative importance of each as a source of *calcium*, *phosphorus* and *iron*. Some are also good carriers of *iodine*.

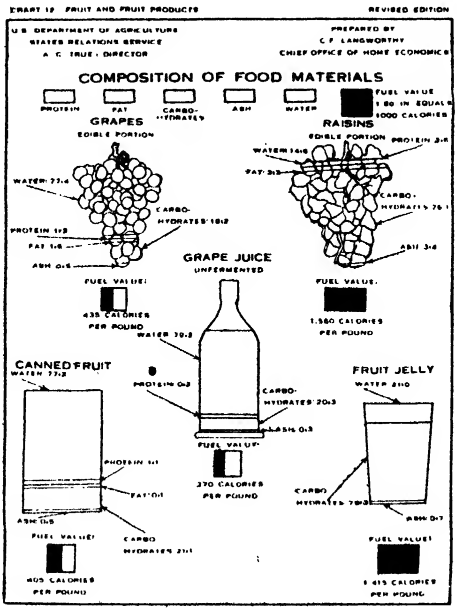


Fig. 144

In India vegetables and fruits have long held their rightful position of importance in the diet. Only of recent years have the western peoples begun to appreciate their value. Scientific investigations have proved the necessity of *mineral salts* and *vitamins* for health and growth. You have learned about these in previous chapters and, therefore,

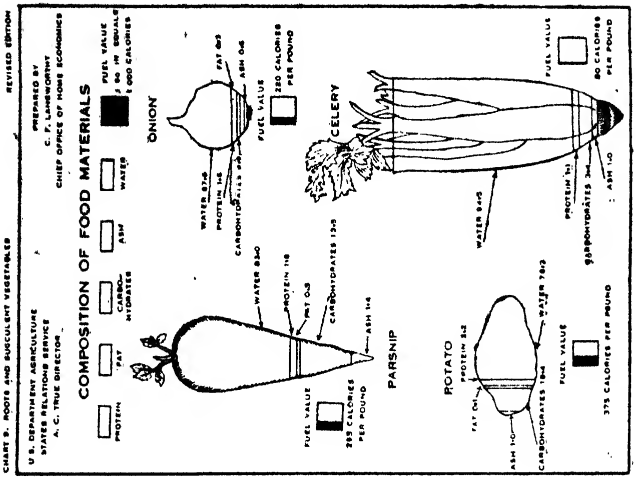


Fig. 146

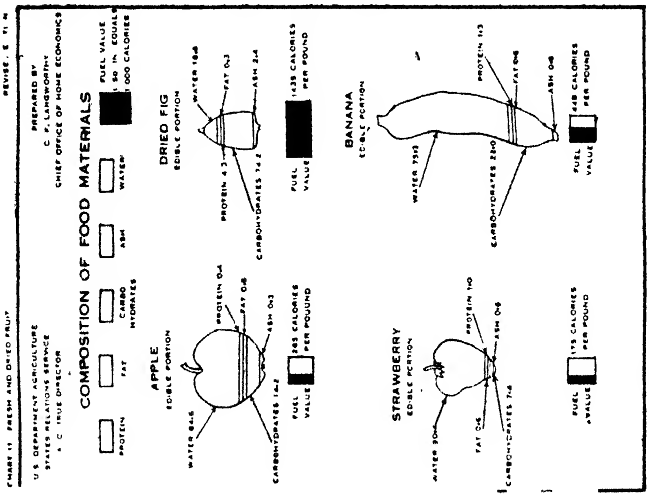


Fig. 145

know that vegetables and fruits are among the richest sources of these food factors. *Calcium*, *phosphorus*, *iron* and *iodine* are all found in vegetables. All the *vitamins* are also found in vegetables and in fruits.

We do not look to fresh vegetables as our chief source of protein, though many of them compare well with foods from animal source. Neither do we expect to secure our calories of heat and energy from green vegetables and succulent fruits, though some are also good fuel foods. We look chiefly to them for vitamins and ash constituents.

PERCENTAGE COMPOSITION

EDIBLE PORTION OF SUCCULENT VEGETABLES

Fresh Vegetables		Protein %	Fat %	Sugars and starches %	Fuel Values	
English	Marathi				Calories per lb.	Grams per 100 calorie portions
Beans (kidney)	Mogary papdi	7·0	·2	18·5	471	96
,, (butter)	Wal ,,	7·1	·7	22·0	557	82
,, (french) or string	Gavar ,,	2·3	·3	7·4	184	241
Cabbage ...	Karam	1·6	·3	5·6	143	317
Carrots ...	Gajra	1·1	·4	9·3	204	221
Cucumbers ...	Tandali ...	·8	·2	3·1	79	575
Egg plant ...	Brinjal	1·2	·3	5·1	126	349
Green corn ...		3·1	1·1	19·7	459	99
Kohl-ralic ...	Nol-kol ...	2·0	·1	5·5	140	324
Lettuce ...		1·2	·3	2·9	87	525
Marrow ...	Dudhi	1·4	·5	9·0	209	217
Okra	Bhindi	1·6	·2	7·4	172	264
Onions	Kande	1·6	·3	8·9	199	228
Peas	Tuar papdi ...	7·0	·5	16·9	454	100
,, (cow) ...	Chauli ,, ...	9·4	·6	22·7	603	76
Potato (white) ...	Batate	2·2	·1	18·4	378	120
,, (sweet) ...	Ratala	1·8	·7	27·4	558	81
Radishes ...	Mula	1·3	·1	5·8	133	341
Spinach... ...	Mehti or poi ...	2·1	·3	3·2	109	417
Tomatoes ...	Tamate ...	·9	·4	3·9	104	438
Turnip		1·3	·2	8·1	178	256

PERCENTAGE COMPOSITION

Edible Portion of Fresh Fruits

Fruits	Water	Protein	Fat	Ash	Sugars and Starches	Acidity Malic-M. Citric-C.	Fuel Values: Calories Per lb.	Fuel Values: Grams per 100 Calorie Portions
Apple ...	84·1	·3	·4	·29	11·1	·47 M	285	157
Apricot ...	85·4	1·0	·1	·59	10·4	1·13 M	255	176
Banana ...	74·8	1·2	·2	·84	19·2	·39 M	445	101
Custard apple ...	71·28	2·13	...	·92	21·3	·2	425	105
Figs (fresh) ...	78·0	1·4	·4	·64	16·2	·17 C	395	113
Guava ...	80·6	1·0	·6	·70	6·1	·62 C	355	126
Jack fruit ...	...	3·75	·88	...	26·21	...	910	49
Lemon ...	89·3	·9	·6	·54	2·2	5·07 C	200	224
Lime ...	86·0	·8	·1	·8	·5	5·9 C	240	182
,, (sweet) ...	89·6	·8	·1	·6	6·0	·16 C	180	249
Mango ...	81·4	·7	·2	·48	13·7	·50 C	335	134
Orange ...	87·2	·9	·2	·47	8·65	·78 C	230	195
Papaya ...	88·7	·6	·1	·62	10·0	·14 C	195	242
Persimmon ...	78·2	·8	·4	·6	15·9	·12 M	395	113
Pine-apple ...	85·3	·4	·2	·42	11·9	·72 C	265	150
Plantain ...	64·7	1·3	·4	·8	25·3	·55 M	635	70
Pomegranate ...	75·8	1·5	1·2	·6	11·9	·79 C	455	98
Tamarind ...	35·25	2·44	...	1·56	30·0	9·3	597	75
Watermelon ...	92·1	·5	·2	·27	6·0	·03 M	140	320

Experiment 85. Grate a white potato, place in butter-muslin or mulmul and let soak in water. Is the sediment left in the water like that from the flour? Test it for starch.

Examine the material left in the cloth. Is it the same as we had in Experiment 78? Test and see. If it is not protein, what can it be? Test it with iodine. Yes, both are carbohydrates. The starch soaks out into the water and the material left in the cloth is *cellulose* or woody fibre.

The woody fibre, or *cellulose*, which holds the vegetables and fruit upright and in form, is not digested by the human being, though herbiverous animals are so constructed that they can utilize the bulky cellulose. Cellulose is of real use to us in another way, acting as 'roughage', it distends the walls of the intestines and stimulates peristalsis. You

might almost liken it to *a broom* which sweeps the waste matter along, so that it can be expelled. Some vegetables and fruits contain acids which stimulate the intestines. Many vegetables also contain magnesium which is laxative. These facts explain why vegetarians are less apt to suffer from constipation than other people. Plenty of green, fresh vegetables should be taken daily, therefore, to supplement the diet of the wheat, bajri and rice eaters, as well as that of those who take a meat diet.

Meat and fish. There are many eastern people who partake of animal food. The Bengali will eat fish; the Mussulman and Parsee and Christian, and some Hindus, will eat meat also. To some people the flavour of these foods gives zest to the meal; but this is a question of habit and attitude of mind and religion. Let us briefly consider the value of meat in the diet.

Animals such as lions and tigers, which are carniverous (that is, eat no vegetable food stuffs), consume the entrails, liver, kidneys and heart of their prey. They drink the blood and crunch the bones. In this way they secure the vitamins and minerals which are lacking in the muscles. Men, however, eat chiefly the muscle of an animal and occasionally the organs, rarely the blood and never the bones.

Meat and fish (Fig. 147) furnish *protein* in about the same proportion as seed grains or cereals. Scientists to-day state that vegetables combined with seed grains form a better diet than meat combined with seed grains can do.

The proteins of meat and fish are *complete*, containing all the essential amino acids. The amount of protein depends upon the amount of *lean* muscle the meat contains. A tola of curds or dhal, or a half seer of milk contains as much protein as a mutton chop or small fish.

Meat and fish contain about as much *phosphorus* as the seed grains and, like them, are low in calcium content. *Iron*

is one of the chief elements of meat, but this is equalled by an egg yolk, two chapattis or slices of whole-wheat bread, or a tola of cooked spinach. Mutton contains a small amount of vitamin B, but is lacking in vitamins A and C. Beef contains some A as well as B vitamin. *Liver* contains all the vitamins. If meat is eaten, it should be taken in a mixed diet with whole seed grains, atta (bread), vegetables, fruits and milk, and not allowed to replace them. Meat protein is complete, but no better than that of milk and eggs. Too much meat in the diet is distinctly bad for us. Protein cannot be completely oxidized and the uric acid tends to produce a condition of ill-health. Meat, two or three times a month, is sufficient with an otherwise balanced diet.

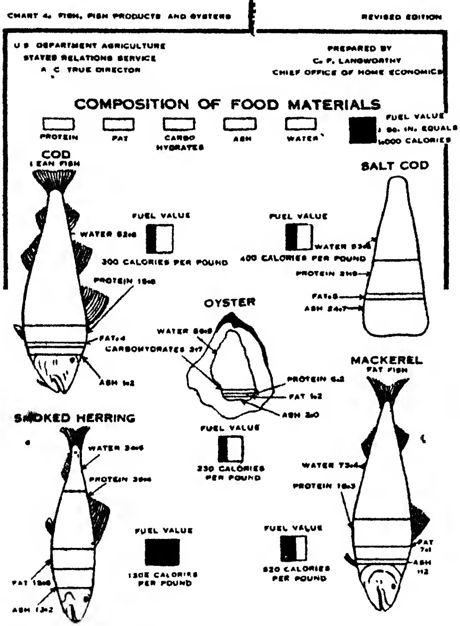


Fig. 147

Dr. Robert McCarrison describes a village in northern India where people are ‘of magnificent physique, preserving until late in life the characters of youth; unusually fertile and long lived and endowed with nervous systems of notable stability’, living on a diet of dried apricots, vegetables, goats’ milk and butter made from the milk. The

meat of the goat is eaten only on feast days. It would thus appear that meat is not essential to a good diet, though it may properly form a part of it.

Eggs. Eggs, like milk, contain *complete proteins*, equal to those of meat and can be substituted for meat in a vegetarian's diet. Like milk, the protein of eggs supplements the

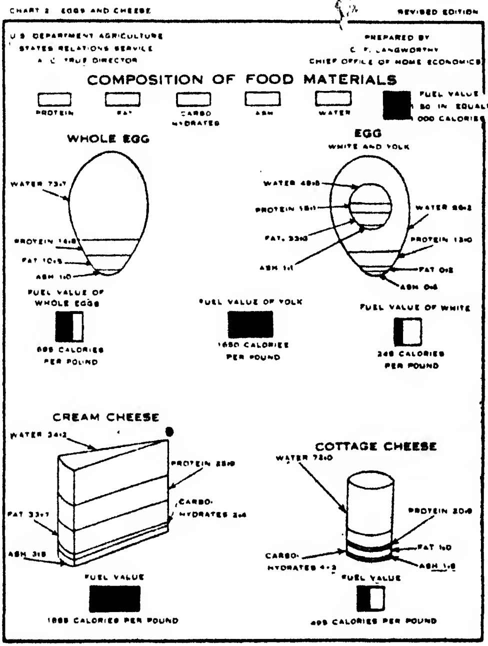


Fig. 148

vegetable proteins of the pulses and grains. They are more concentrated than milk and, therefore, after a child begins to eat other foods, the milk may be lessened in quantity and eggs added. After a child is six years old, a quart of milk would not furnish sufficient protein; so dhal, egg or meat may be used to increase the protein supply. Two ounces of dhal, supplemented with two ounces of fish or three ounces

of egg or fourteen ounces of milk, is better than four ounces of dhal. The yolk, or yellow of the egg, is rich in *fat* and *ash* constituents. *Calcium*, *phosphorus* and *iron* are all abundant in the yolk. This part of the egg also contains vitamins A, B and D. Do you recall the value of these vitamins? (Fig. 148).

The ovum or egg *must be fertilized* before life is created. Hens that are kept away from the rooster will lay *un*fertilized eggs, incapable of producing life. No chick could possibly be hatched from such eggs. Therefore, we can look upon unfertile eggs as the 'milk of the hen', and any vegetarian Hindu can eat them without apprehension. In fact, unfertilized eggs keep better and are, therefore, raised for market.

TABLE SHOWING COMPARATIVE COMPOSITION OF SOME PROTEIN FOODS

Food	Protein	Fat	Carbo-hydrate	Fuel value per lb. calories	100 calorie portion grams
Bajri (millet) ...	11·68	5·5	74·68	1635	28
Beef (lean) ...	18·9	12·2	...	842	54
Bread (whole wheat)	9·7	·9	49·7	1113	41
Curds (dhahi) ...	20·9	1·0	4·3	499	91
Cheese (panir) ...	28·8	35·9	·3	1990	23
Chicken (murghi) ...	21·5	2·5	...	493	92
Eggs (ande) ...	13·4	10·5	...	672	68
Fish (masa) ...	18·8	9·5	...	727	61
Flour (maida) ...	13·8	1·9	71·9	1630	28
Liver	20·4	4·5	1·7	583	78
Lobster (shevand) ...	16·4	1·8	·4	379	120
Milk, cows' (dudh)...	3·6	5·7	4·7	380	120
Mutton (gosh) ...	19·8	12·4	...	863	52
Oysters	6·2	1·2	3·7	228	199
Mungphali (ground-nuts)	25·8	38·6	24·4	2490	18
Tur dhal ...	22·89	1·35	69·31	1610	38
Wal, dried ...	22·4	1·4	54·2	1347	34

Milk (Fig. 149). While reverencing life in all animals, the ancient Hindu law-makers gave especial honour to the cow,

They must have realized the importance of milk and its products as a necessary food for young and old.

People living in a tropical climate do well to follow a vegetarian diet, if to it they add a plentiful allowance of milk, curds or cheese and butter or ghee. In these modern days, with reduced grazing and city crowding, the supply and quality of milk falls far short of our requirements. Not only Hindus, but *all* races suffer from lessened milk supply and joint effort should be made to develop better breeding, feeding and sanitation, for the cows and buffalo. Unless they are well-fed and cared for, the milk supply decreases both in quality and quantity. Cows respond to kindness and amply reward good care. This is true economy and dietetic wisdom. The protein secured from cows fed on an acre of cultivated land, in the form of milk, is four times as great as could be secured by killing them and eating the flesh.

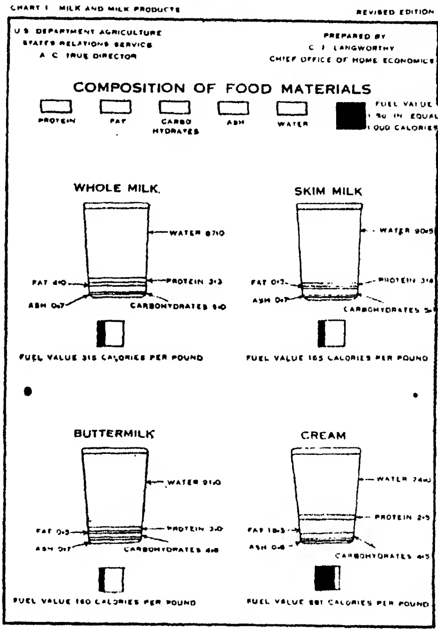
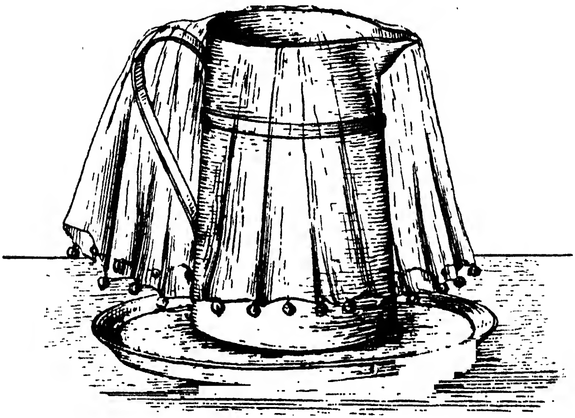


Fig. 149

Milk requires *especial care* in a tropical climate. Can you tell the reason? What makes milk sour? Look back

to the chapter on micro-organisms. Not only must the surroundings of the cow, the shed and pen be clean, but the cow's udder must be washed with clean water before she is milked. The milker, too, should prepare for this work as carefully as she would prepare to enter a kitchen to cook the food. A bath, clean clothing and clean vessels are all important in keeping the milk clean. The *lota*, or vessel,



The illustration shows how to keep a jug free from flies. If the muslin cloth is made so as to reach the dish of water in which the jug stands, the liquid in the jug will be kept cool.

The dish should not be stood in the house or in a closed cupboard, but in a safe, standing in a draughty place in the open air on the shady side of the house, free from dust and as remote as possible from drain openings, rubbish heaps or garbage of any kind.

in which the milk is caught should be thoroughly washed and rinsed, first in boiling hot water and then cool water. The milk-vessel should be covered with clean mulmul as shown above and stood in a pan of cold water to cool quickly. It is nothing short of murder for a milkman to dilute the milk with water (often dirty infected water also),

The result of such conduct upon a baby's growth is similar to what you saw in the picture of rats.

Infection is readily carried by milk, as it furnishes a dilute food for micro-organisms. Bacteria like the milk warm, so we can prevent their growth by keeping it cool.

The method in which milk is delivered by train and carried on the heads of coolies, with the top of the can open or stuffed with grass, is most dangerous. When we must buy such milk, our only safety is in *boiling* it. *Heat it quickly* and boil it for two minutes and then *cool it quickly*. In this way we purify it, but destroy fewer vitamins than in slow and long heating.

Milk differs in the proportion of its constituents according to the environment of the animal and the rapidity of growth of its young. The calf grows more rapidly than a baby and therefore cows' milk is richer in tissue-building materials, protein and ash, than is human breast milk. The buffalo calf is larger and likes to swim in water, so nature has provided not only more protein and ash in its mother's milk, but also more fat to keep it warm in the water.

Milk from the cow and buffalo not only differ from each other, but the same animal's milk is different in the proportion of its constituents at various seasons and even at different times of the day, as well as on different rations. The milk from cows of different breeds and in different countries and climates has, therefore, quite a variation in the proportion of the food substances. The following table indicates the average composition of New Zealand and Indian cows' milk compared with that of the buffalo and goat. This is of great importance when it comes to modifying milk for infants' food.

The character of the food constituents in milk is a matter of much importance and we will now consider these (Fig. 149).

Milk protein. This is familiar to you in the form of

PERCENTAGE COMPOSITION OF MILK

Milk	Water	Fat	Protein	Sugar	Ash	Calories per lb.
Humanized milk ...	...	3·0	1·3	7·0	...	178
Mothers' breast-milk ...	88·3	3·5	1·3	7·0	·3	288
New Zealand cows' milk ...	87·0	3·5	3·5	5·0	·7	320
Goats' milk	85·7	4·7	4·5	4·5	·8	350
Indian cows' milk ...	85·28	5·7	3·6	4·7	·77	380
Water buffaloes' milk ...	81·73	8·0	4·5	5·0	·8	500
Pedha (condensed and sweetened milk) ...	28·0	9·0	7·8	53·5	1·7	1630
Mawa (evaporated, unsweetened milk) ...	73·0	8·0	7·0	10·5	1·5	710
Whole milk powder ...	4·0	29·0	25·5	36·0	5·5	2530
Skim milk powder ...	3·0	2·0	35·5	51·5	8·0	1830

curds, though there are other proteins dissolved in the whey of the milk. Milk proteins are *complete*, that is, they contain all the essential amino acids. The proteins are known as 'body or tissue building material'. Since some of our root vegetable and cereal proteins are *incomplete*, the use of milk with vegetable foods is a protection. Milk contains the essential amino acids which pulses and food grains lack. In fact, milk protein is one of the best obtainable from any source. It would seem that the Hindu law, making a food 'etha' by cooking it with milk, has a sound scientific basis.

Goats' milk is often used for children and is better than cows' milk in some respects. Its iron content is higher. Its fat droplets are smaller, give a more thorough emulsification, are more easily digested, and are richer in vitamins A and D than cows' milk. The curd, too, is finer and children are often able to tolerate goats' milk when they cannot digest the cows' milk. As goats are not susceptible to tuberculosis, the milk may be used with greater safety.

We give the rule for using goats' milk for baby's food as

well as that of cows' and buffaloes' milk[1] because one must use the milk that is available. Goats' milk, however, is preferable to cows' milk which is better for baby than buffaloes' milk, if you have a choice.

Curds and cheese. Ancient people of other countries found that it was possible to preserve the curds of milk if they drained out most of the moisture (whey) and kept the curds in a cool place. Sometimes they buried it or put it away in caves. Moulds and bacteria attacked it, changing its flavour, but not destroying it. Necessity caused them to eat it and custom has taught them to like it. Cheese is, therefore, a recognized food in the west, while we in the east prefer to eat the fresh curds. It is possible now to secure cheese made in India without the use of rennet and, where milk and curds are scarce, cheese could be used without offence to custom. A pound of cheese contains the protein from four quarts of milk. It is rich in fat and in ash constituents, calcium, phosphorus and iron, and can well be substituted for meat in the diet (Fig. 148).

Curds or cheese, taken with whole-wheat bread or chappatti and fruit, makes a diet adequate for a man if eaten in sufficient quantity to make up the calories.

Milk fat. The fat of milk is in the form of tiny globules which rise to the top when milk is allowed to stand. We call it cream. We churn the cream to make butter. The fat of milk not only *yields heat and energy*, but supplies vitamin A and a little vitamin D which we have learned is necessary for growth and health. The custom of clarifying butter to make *ghee* arose from the same necessity as that for making cheese. In a hot climate, butter will become rancid quickly by the action of micro-organisms. It was found that boiling

[1] The analysis of Indian cows' and buffaloes' milk is taken from *Memoirs of The Department of Agriculture in India*, Chemical Series, Vol. II, Nos. 1 and 4, by Dr. A. A. Meggitt and Dr. H. H. Mann, Agricultural Research Institute, Pusa.

out the water which butter contains also hardened the protein present, which could be strained out. It should be boiled in a *closed vessel*, as vitamin A will be destroyed if it is not kept away from the air. Such a condensed form of fat is not attacked by ferments and it will keep much longer than butter. It is an excellent source of heat and energy, but is likely to be adulterated.

Mineral ash. The minerals of milk are found in the *whey* or fluid of the milk. There is more *calcium chuna* (lime) in a quart of milk than in a quart of 'limewater'. Why does a child require calcium in its diet? Similarly milk contains a good supply of *phosphorus* and we thus see it is a food best adapted to growing children who need material for their bones and teeth. The *iron* in milk is in an excellent form, which is readily absorbed and used by the body, but there is not enough of it to supply all that is needed. What could you take with milk that would add iron to the diet?

Vitamins. Milk contains vitamins A, B and some D, and if the cow is fed on *green* food her milk also contains vitamin C. We must not forget that vitamin C is destroyed when milk is heated. Do you know what else to give the baby if she has to have boiled milk? Half a tola (a tablespoonful) of orange, tomato, carrot or Swedish turnip *juice* will supply the need.

Sugar of milk is found in the fluid 'whey' and may be evaporated out. Sometimes we buy it from the chemist to use in modifying milk for the baby, as it is a better form of sugar than gul or shakker. It does not ferment so easily, and is less sweet. Sugar is a carbohydrate as you know and is a quick source of energy and heat.

Water. The protein, fat, sugar, minerals and vitamins of milk are held in an emulsion with water. Food in this liquid condition is easily attacked by bacteria and yeasts, and we therefore have to keep it clean and cold and covered to

prevent from souring. Let us try to save in other directions, so that we can afford an adequate supply of milk for the family. How much should a child have each day? How much do adults require? What is the price of milk? Calculate the cost of buying one quart (two seers) of milk for each child and a pint (one seer) for each adult.

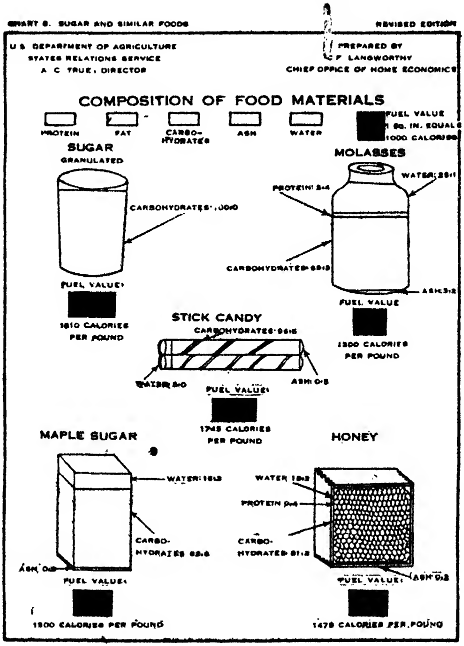


Fig. 150

Evaporated and condensed milk. Mawa and pedha are the products of experience and the necessity of keeping milk from spoiling. They contain all the ingredients of milk with the exception of water. Pedha has had sugar added, which also assists in its preservation. Micro-organisms cannot live in such concentrated foods, which is the secret of their preservation. Mawa and pedha are excellent

foods, if clean and unadulterated, and form the basis of such sweets as barfee which, with nuts and spices added, forms a singularly nutritious as well as an appetizing food.

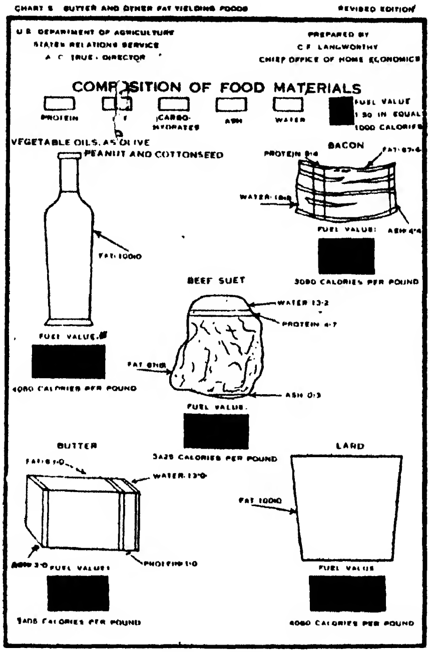


Fig. 151

In India, milk is the one food of animal origin which is universally used. With a diet of food grains and vegetables, milk and its products supply all the necessary factors to supplement any deficiencies which a vegetarian diet might otherwise have.

For the composition and food values of certain fats and sugars, see Figs. 150 and 151.

AGENDA

Oral and Practical Work

1. Why is wheat used by people of all nations for bread ?
2. Why is atta a better food than maida ?
3. What is the protein of cereal grains called ? How would you recognize it ?
4. What is the test for starch ?
5. What minerals are most prominent in cereal grains ?
6. What vitamin do cereal grains contain ? What value is this vitamin to us ?
7. Compare the composition of the cereal grains which you use at home.
8. Are nuts of food value ?
9. How would you classify vegetables ?
10. What vitamins do they supply ? Can you explain what happens to us if our food is lacking in them ?
11. What mineral salts are found in vegetables ? Do you remember their value ?
12. What good purpose does the cellulose perform ?
13. Compare the food value of meat with seed grains and dhal.
14. Can a suitable diet, adequate in all respects, be provided without meat or fish.
15. What foods may be used to provide a complete protein supply ?
16. Why is milk called a 'protective food' ? Name all its good qualities.
17. How shall we keep the milk cool, clean and safe from infection ?
18. In what respects does the milk of animals differ ?
19. What is the best substitute for mothers' milk ?
20. What is cheese ? How is it made ? What value has it ? How does it differ from curds ?
21. Why was ghee originally made ? Under what conditions should butter be heated to avoid destruction of vitamins ?
22. How can milk be preserved ?

Exercise 12

1. Make some fresh cheese or curds.
2. Make ghee from butter.

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CHAPTER XIII

FOOD FOR THE FAMILY

'Healthy babies make strong men and women.'

Required.—Chatti, jug, spoon, bottles, weights and scales, sugar, milk, mulmul, barley, rice, soji, spinach, chuna, boiling water.

Food for the baby. The mother's milk is the *baby's natural food*, and for this there is no perfect substitute. Babies that are nursed are stronger and develop better health than babies that have to live on artificial milk substitutes. Babies that feed upon their mothers' milk have eight times as good a chance of not having diarrhœa as bottle-fed babies have. Five times the number of babies die when bottle-fed as when nursed on mothers' milk.

Whether a baby is weaned at the ninth month or still suckled, some dry solid food such as crust of bread or dry crisp toast should be introduced into his dietary about this time, so as to train early the powers of munching and chewing and thus induce without delay a proper flow of saliva. The solid food should form part of the meal and should be commenced about ten minutes before any milk is given, otherwise he tends not to keep hard at work. These activities lead to increased flow of blood to the region of the mouth and cause thereby increased growth and development of jaws, teeth, roof of mouth and airway of nose, preventing adenoids.

Normally, you should begin to wean a baby by the time it is nine or ten months old. It is a mistake to continue nursing a big child after a year. To continue nursing for two years or more is bad for the baby and also for the mother. When weaning, begin feeding the baby with cup or

spoon, four or five ounces of gruel made from soji or barley or oat flour. Cook the soji with water for an hour and a half, and strain. Add two or three ounces of cows' milk to the cooked soji and a *tiny* bit of sugar. After a few weeks the amount may be increased to two feedings a day. The corresponding number of breast-feedings should, of course, be discontinued. The baby should also be given *orange juice* or *tomato juice*, strained and diluted with water, beginning with *two teaspoonfuls* and increasing to *three tablespoonfuls*, once a day between feedings. The baby should also be given water to drink, at least four times a day, between the four-hour feedings. If this is given in a bottle he becomes accustomed to it and this makes weaning easier. If weaning is gradual, it should be completed by twelve months unless the time of completion comes in the hot weather.

If it becomes necessary, by reason of sickness or the death of the mother, to feed a baby in an artificial way, the nearest substitute for mothers' milk is the milk of the *goat or cow*. By examining the figures showing the comparative composition of the different kinds of milk, you will realize that they are not identical and that we must *modify* the cows', goats' or buffaloes' milk to make it more nearly resemble the mothers' milk.

In order to do this intelligently, we should study the chapter on *milk* carefully. Most of these calculations have been figured out for us and we have only to determine the proportion required for the individual child. But we must have food which the baby can digest and he cannot be expected to eat the same food a grown person does, any more than he could wear his father's clothes. Our first problem is to get clean whole milk and to know its source and composition. Then we must weigh the baby. Next we must understand that food is measured not only in pounds and ounces, seers and tolas, but according to the amount of heat and energy it produces when digested or oxidized. We

measure the quantity of heat by the *calorie.* What is a calorie?

Now let us consider the amount of food the baby requires according to its size and age and by what method we can prepare cows' milk to meet its requirements.[1]

Estimation of the number of calories required by a baby is made on the following basis: a baby under three months of age requires 50 calories of food per pound of weight of the baby. A baby from three to five months old requires 45 calories per pound of its weight, and after that for the rest of the year 40 calories per pound of body weight is sufficient. He should have from 11 to 13 calories in the form of protein for every 100 total calories.

It is comparatively easy to estimate the formula of food for the baby if fresh clean milk and milk sugar are available. But when we cannot afford much milk and are unable to buy milk sugar, the problem is more difficult, but not impossible. We will learn both methods and then you will not be at a loss to nourish the baby under any circumstances.

As an example, a baby three months old, weighing about 10½ lb., would require approximately 472 calories of food in 24 hours, which should be furnished in the form of 30 ounces of modified or humanized milk.

The following tables are made out for the humanizing of cows' milk as estimated both in ounces and tolas. Also tables are given for the use of goats' milk in making up formulæ for baby's food.

Study the tables carefully. The age of the baby is given in the first column, then the number of times per day he should be fed at that age. The amount of food he should have at each meal and the amount for the whole twenty-four hours is next shown.

[1] *Table of Artificial Feeding*, adapted from the tables prepared by Sir F. Truby King, C.M.G., and issued by the Royal New Zealand Society for the Health of Women and Children, *Feeding and Care of Baby.*

In the next set of columns you have the recipe for mixing his food, that is, the amount of each ingredient he should have at that age.

The last columns give further additions allowable in his diet as he grows older.

FEEDING TABLE FOR USE WITH COWS' MILK.

Table for artificial feeding from birth, of healthy babies, based on the average weight for age in quantities for twenty-four hours.

SHOWING WEIGHT IN OUNCES

1 oz. = 2½ tablespoon (sugar) 16 oz. = 1 lb.

Age of baby	Number of feedings given in 24 hours	Right amounts of food to give		In preparing the baby's food, use these quantities of each ingredient in mixture for 24 hours				Valuable additions to diet of baby in 24 hours				
		Amount at each feeding	Total food for 24 hours	Cows' milk boiled	Sugar	Cod liver oil	Boiled water	Orange juice (with boiled water)	Cereal jelly (kanji)	Stale toasted bread or chapati	Green vegetable pulp	Egg yolk
1st and 2nd day...	Give only warm water which has been boiled											
		oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.			
3rd day ...	6	1	6	1	1/16	...	5	...	...	...	...	...
4th ,, ...	6	1½	9	1½	⅛	...	7½	...	...	...	...	...
5th ,, ...	6	2	12	2	¼	...	10	...	...	...	...	...
7th ,, ...	6	2½	15	2½	⅜	...	12½	...	...	...	...	...
10th ,, ...	6	3	18	5	⅝	...	13	...	...	...	...	...
3rd week	6	3½	21	6	⅞	1/24	15	...	...	...	...	...
4th ,, ...	6	4	24	7	1⅛	1/12	17	...	...	...	...	...
2nd month	6 or 5	4½ or 5	25½	9	1¼	1/12	16½	1/12	...	...	...	...
3rd ,, ...	5	5½	27½	11	1⅜	⅙	16½	⅙	...	...	...	...
4th ,, ...	5	6	30	12	1½	⅙	18	¼	...	...	1 tsp.	...
5th ,, ...	5	6½	32½	13	1⅝	⅙	19½	⅓	...	...	2 ,,	...
6th ,, ...	5	7	35	14	1¾	¼	21	½	⅓	½	1 tb.	...
7th ,, ...	5	7½	37½	15	1⅞	¼	22½	½	1	½	,,	...
8th ,, ...	5	8	40	16	2	⅓	24	½	1	1	2 tb.	1 tsp.
9th ,, ...	5	8	40	17	2	⅓	23	⅔	1½	1	,,	,,
10th ,, ...	5	8	40	18	2	¼	22	⅔	1½	1	,,	,,
11th ,, ...	5	7 or 8	40	18	2	¼	22	1	2	1	3 tb.	,,
12th ,, ...	5	7	35	19	1½	¼	16	1	2	1	,,	,,

FEEDING TABLE FOR USE WITH COWS' MILK

Table for artificial feeding from birth, of healthy babies, based on the average weight for age in quantities for twenty-four hours.

SHOWING WEIGHT IN TOLAS

4 masa = 1 teaspoon (sugar) 12 masas = 1 tola
1 tola = 1 tablespoon (sugar) 40 tolas = 1 seer

Age of baby	Number of feedings given in 24 hours	Right amounts of food to give: Amount at each feeding	Right amounts of food to give: Total food for 24 hours	In preparing the baby's food, use these quantities of each ingredient in mixture for 24 hours: Cows' milk boiled	Sugar	Cod liver oil	Boiled water	Valuable additions to diet of baby in 24 hours: Orange juice (with boiled water)	Cereal jelly	Stale toasted Bread	Green vegetable pulp	Egg yolk
1st and 2nd day ...	Give only warm water which has been boiled											
		Tola	Tola	Tola	Masa	Masa	Tola	Masa	Tola	Chapati	Masa	Masa
3rd day ...	6	2½	15	2½	2	...	12½	...	...	...	...	...
4th ,, ...	6	3¾	22½	3¾	4	...	18¾	...	...	...	...	...
5th ,, ...	6	5	30	5	8	...	25	...	...	...	...	...
7th ,, ...	6	6¼	37½	6¼	12	...	31¼	...	...	...	...	...
10th ,, ...	6	7½	45	12½	20	...	32½	...	...	...	...	...
3rd week ...	6	8¾	52½	15	28	1	37½	...	...	...	...	...
4th ,, ...	6	10	60	17½	34	2	42½	...	...	...	...	...
2nd month	6 or 5	12½	63¾	22½	38	3	41¼	2½	...	...	...	...
3rd ,,	5	13¾	68¾	27½	42	5	41½	5	...	...	...	...
4th ,,	5	15	75	28	45	5	45	7½	...	...	4	...
5th ,,	5	16$\frac{3}{10}$	81¼	32½	50	5	48¾	10	...	...	8	...
6th ,,	5	17½	87½	35	53	7	52½	15	⅔	¼	½	...
7th ,,	5	18¾	93¾	37½	58	8	56¼	15	2	½	12	...
8th ,,	5	20	100	40	60	10	60	15	2	½	24	4
9th ,,	5	20	100	42½	60	10	57½	20	3	½	24	4
10th ,,	5	20	100	45	60	8	55	20	3	½	24	4
11th ,,	5	20	100	45	60	8	55	30	4	¾	36	4
12th ,,	5	18	87½	47½	45	8	40	30	4	¾	36	4

FEEDING TABLE FOR USE WITH GOATS' MILK

Table for artificial feeding from birth, of healthy babies, based on the average weight for age in quantities for twenty-four hours.

Age of baby	Number of feedings given in 24 hours	Right amounts of food to give		In preparing the baby's food, use these quantities of each ingredient in mixture for 24 hours				Valuable additions to diet of baby in 24 hours				
		Amount at each feeding	Total food for 24 hours	Goats' milk boiled	Sugar	Cod liver oil	Boiled water	Orange juice	Cereal jelly	Stale toasted bread	Green vegetable pulp	Egg yolk
1st and 2nd day...	Give only warm water which has been boiled											
		oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.			
3rd day...	6	1	6	1	1/16	...	5	...	...	...	...	...
4th ,, ...	6	1½	9	1½	⅛	...	7½	...	...	...	...	...
5th ,, ...	6	2	12	2	¼	1/24	10	...	...	...	...	...
7th ,, ...	6	2½	15	2½	⅜	1/12	12½	...	...	...	...	...
10th ,, ...	6	3	18	4	⅝	⅙	14	...	...	...	...	...
3rd week	6	3½	21	5	⅞	⅙	16	...	...	...	...	...
4th ,,	6	4	24	6½	1⅛	⅙	17½	1/12	...	...	...	...
2nd month	5 or 6	4½ or 5	25½	8	1¼	¼	17½	⅙	...	...	...	...
3rd ,,	5	5½	27½	9½	1⅜	⅓	18	¼	...	...	...	...
4th ,,	5	6	30	11	1½	5/12	19	⅓	...	...	1 tsp.	...
5th ,,	5	6½	32½	12	1⅝	½	20½	½	...	...	2 ,,	...
6th ,,	5	7	35	13	1¾	½	22	½	⅓	½	1 tb.	...
7th ,,	5	7½	37½	14	2	½	23½	½	1	½	,,	...
8th ,,	5	8	40	15	2⅛	½	25	⅔	1	1	2 tb.	1 tsp.
9th ,,	5	8	40	15	2⅛	½	25	⅔	1½	1	,,	,,
10th ,,	5	8	40	16	2	½	24	1	1½	1	,,	,,
11th ,,	5	7 or 8	40	17	1¾	⅓	23	1	2	1	3 tb.	,,
12th ,,	5	7	35	17	1¼	¼	18	1	2	1	,,	,,

Buffaloes' milk is really *not suitable* for an infant, as the fat is not only larger in amount, but it is in the form of large globules *very difficult* to digest. Buffaloes' milk may be used instead of goats' milk, if it is absolutely necessary, *after the baby is 3 months old and thriving.* Every effort should be made to secure goats' milk for young or delicate babies and it is better to use it at all times if possible.

FEEDING TABLE FOR USE WITH GOATS' MILK

Table for artificial feeding from birth, of healthy babies, based on the average weight for age in quantities for twenty-four hours.

SHOWING WEIGHT IN TOLAS

Age of baby	Number of feedings given in each 24 hours	Right amounts of food to give		In preparing the baby's food, use the quantities of each ingredient in mixture				Valuable additions to diet of baby in 24 hours				
		Amount at each feeding	Total food for 24 hours	Goats' milk boiled	Sugar	Cod liver oil	Boiled water	Orange juice	Cereal jelly	Stale toasted bread	Green vegetable pulp	Egg yolk
1st and 2nd day...	Give only warm water which has been boiled											
		Tola	Tola	Tola	Masa	Masa	Tola	Masa	Tola	Chapati	Masa	Masa
3rd day...	6	2½	15	2½	2	...	12½	...	...	...	...	...
4th ,, ...	6	3¾	22½	3¾	4	...	18¾	...	...	...	...	...
5th ,, ...	6	5	30	5	8	1	25	...	...	...	...	...
7th ,, ...	6	6¼	37½	6¼	12	2	31¼	...	...	...	...	...
10th ,, ...	6	7½	45	10	20	3	35	...	...	...	...	...
3rd week	6	8¾	52½	12½	28	4	40	...	...	...	...	...
4th ,, ...	6	10	60	$16\frac{3}{10}$	34	5	43¾	...	..	...	...	...
2nd month	5	12½	63¾	20	38	7	43¾	2½	...	...	...	...
3rd ,, ...	5	13¾	68¾	24½	42	10	45	5	...	...	...	...
4th ,, ...	5	15	75	27½	45	12	47½	7½	...	...	4	...
5th ,, ...	5	$16\frac{3}{10}$	81¼	30	50	15	51¼	10	...	...	8	...
6th ,, ...	5	17½	87½	32½	53	15	55	15	⅔	¼	12	...
7th ,, ...	5	18¾	93¾	35	60	15	58¾	15	2	½	12	...
8th ,, ...	5	20	100	37½	64	15	62½	15	2	½	24	4
9th ,, ...	5	20	100	37½	64	15	62½	20	3	½	24	4
10th ,, ...	5	20	100	40	60	15	60	20	3	½	24	4
11th ,, ...	5	20	100	42½	53	10	57½	30	4	½	36	4
12th ,, ...	5	18	87½	42½	38	8	45	30	4	¾	36	4

The following recipes are for making 'humanized milk' with buffaloes' milk *in case no other milk is available.* The large amount is enough for a whole day for a baby over 7 or 8 months old. The small amount is enough for one feed.

1.	Buffaloes' milk (boiled) ...	15 oz.	}	= 42 oz.
	Sugar	2 ,,		
	Boiled water	25 ,,		
2.	Buffaloes' milk (boiled) ...	3 ,,	}	= $8\frac{3}{8}$ oz.
	Sugar	$\frac{3}{8}$,,		
	Boiled water	5 ,,		

Mix the ingredients. Strain very carefully. Observe all the rules given under the table for artificial feeding.

No feeding table can be an absolute guide as to the quantity and strength of food needed for a given baby.

No infant needs food stronger than shown in the recipes, during the first few months at any rate and babies with a tendency to weak digestion may thrive better if the food is given weaker for a time; that is to say, if given a little less milk, sugar and oil, or a little boiled water to make up the total quantity.

Premature babies should always begin with food more diluted than shown in the table and the advance in strength must be more cautious. *Although 'humanized milk' has nearly the same strength as mothers' milk, it is not nearly so easy to digest and should never be given full strength to start with.* This applies to all humanized milk, whichever recipe is used. If baby has been fed at the breast and is suddenly weaned, start with food only half strength, or weaker if the baby is delicate and work gradually up to full strength in one or two weeks. It is best to start without any cod liver oil and to work this up very cautiously. Food given too strong at first or with too much oil may cause vomiting and diarrhœa.

Note carefully : Boil all milk used. For young or delicate babies boil for ten minutes. For older babies boil for three to five minutes. Use only *boiled water.* Keep all milk *clean, covered* and as *cool* as possible. Sugar of milk is best, especially for young babies. Pure, granulated cane sugar is next best. All recipes given are made out for use with milk sugar or granulated sugar. If moist sugar must be used, $1\frac{1}{2}$

times as much as milk sugar will be necessary. Be careful not to give too much cod liver oil. If it seems to disagree, give a little less.

Fresh fruit juice is very important for all bottle-fed babies. It must *not* be boiled, only diluted with boiled water. It is important to teach baby to chew as soon as he has teeth. Give crusts just before meals, when baby is hungry.

Feed baby at regular intervals every three or four hours during the day and stop the night feeding as soon as you can. Only give boiled water or fruit juice between meals.

Too much food, or food given too frequently or too strong, causes baby to be sick, to have diarrhœa and to lose weight.

In circumstances where fresh clean milk (either cows', goats' or buffaloes') is not obtainable, or does not agree with the baby, condensed or *dried whole milk* may be used instead. Fresh milk is better than dried or condensed for general use. Be especially careful to give baby orange or other fresh juice every day when giving condensed or dried milk mixtures. If circumstances are such that fresh milk is *unobtainable*, it may be possible to save the baby by using the following *recipes for making humanized milk with condensed or dried milk.*

To make 8 oz. (enough for two feeds for a baby one month old, and enough for one feed for a baby of seven months and onwards).

I. *Dried whole milk* (cows') ...	1¼ oz.
Sugar	⅜ ,,
Water	8 ,,
Cod liver oil	1/12 oz.

To make all these mixtures: mix the milk and sugar with boiling water, bring mixture to the boil and then cool quickly.

II. *Condensed milk* (made from cows' milk)—

Mawa (unsweetened)	1½ oz.
Sugar	⅜ ,,
Water	6½ ,,
Cod liver oil	1/10 oz.

Give the oil separately by spoon, at the same time as the bottle.

Use only clean and scalded utensils, as described before.

Notice that the quantities of ingredients given in these tables are *for twenty-four hours*, not for single feeds.

If it is not convenient or advisable to make the twenty-four hours' supply at once, it is best to make *half the quantity* specified in the tables *twice a day*.

How to prepare the food. First, carefully and thoroughly cleanse all utensils, including the bottles and nipples. Then *scald them* with *boiling* water. Do not dry on a cloth, it may not be clean. They will dry sufficiently after being scalded if the water is boiling, as it should be.

Now measure the sugar into the jug, add the boiling water and stir till sugar is melted. Add the boiled milk and mix well. Now bring the mixture just to the boil again. Then cool it as quickly and thoroughly as can be. Keep it in a clean place, out of sun and in a draught, and as cool as possible. The jug must be covered to keep out flies and dirt, but not so closely as to exclude air. Stir before using.

Do *not* add the oil to the other ingredients. It will not mix. Instead, when making the first lot of milk, measure out the required amount of oil for the day into a small covered vessel.

Give a little (roughly one-fifth or one-sixth, according to whether the baby is having 5 or 6 feeds a day) from a spoon immediately before or during each feed.

Never give food either *cold* or *hot* to a baby. Warm it to blood heat (about 100° F.). To do this stand the feeding bottle in a vessel of hot water for a few minutes, just before feeding time.

Feeding bottles. It is important that the feeding bottle selected should be of the right kind. A feeder with a long tube is most unhygienic because it is impossible to keep it

perfectly clean. The boat-shaped bottles have only one virtue and that is that water can be flushed through both ends. The two openings require rubber stopper and teat, and, considering how quickly rubber deteriorates in a hot climate, this is a grave fault. They are, therefore, *not* recommended.

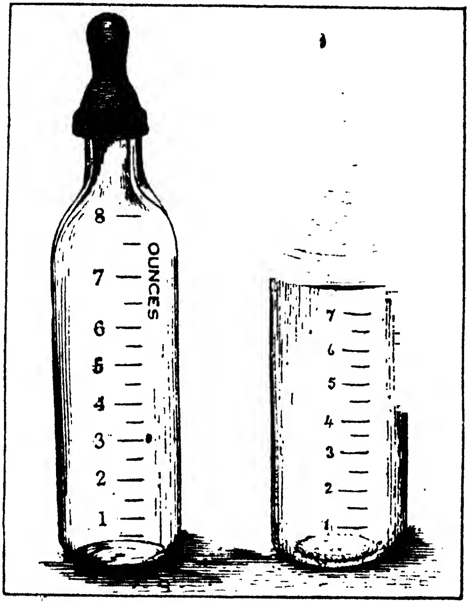

Fig. 152
Approved nursing bottles

Any bottle, such as medicine comes in, can be used, if it is fitted with a rubber nipple or teat and is kept sterilized. Bottle brushes can be secured, which makes the cleaning easy. The best type of bottle is that known as the *Hygeia Feeder* (Fig. 152). Here, instead of a bottle, an open glass jar is used. This jar is covered by an indiarubber cap (Fig. 153). There is no trouble whatever in keeping the

vessel perfectly clean without the use of a brush. The hole in the nipple must be of the right size. If it is too large, the milk will run so rapidly that baby will have indigestion. If the opening is too *small*, he may grow discouraged and leave off before he has finished. He is also likely to swallow a good deal of air in his endeavours to satisfy his hunger, thus causing colic (Fig. 152).

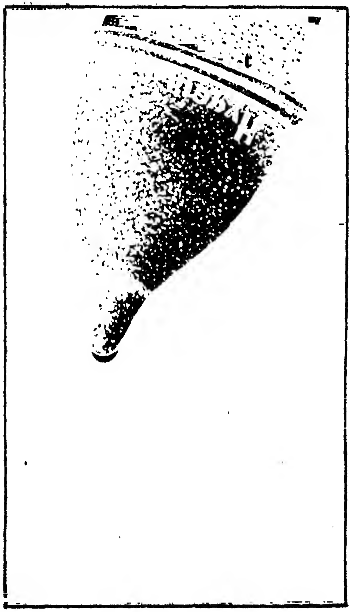

Fig. 153
Hole right for average healthy baby
(From *Feeding and Care of Baby*, by Sir Truby King. Royal New Zealand Society for Health of Women and Children.)

Care of the feeder. You well understand now the importance of perfect cleanliness in everything which pertains to the baby; but in no case is there greater need of *sterilization* than in the care of the bottles and the rubber nipples. They should be rinsed *immediately* in cold water, then washed in hot water. Fill the bottles with water and let them stand until time for using them again. The nipples, after being similarly washed, should be dried quickly in the sun; cover them with material to keep off flies. As previously directed, everything should be scalded with *boiling* water before using.

Fruit juice. In all cases of artificial feeding, give a little fresh fruit juice daily to infants from three or four months old onwards, to compensate for the something that may be wanting in any prepared food. Orange juice is best, but the

juice of lemons or tomatoes may be used. Make sure that no part of the fruit is decomposed, prepare the juice immediately before use and carefully strain so that none of the solid may be included. It is best given about midway between meals, when baby is awake and should be diluted with twice its volume of water which has been boiled and allowed to cool. If very sour, as in the case of lemon juice, a little ordinary sugar may be added. The use of fruit juice may be begun at any time after the first month, starting with ten drops daily, increasing at first by a drop or two a day and later by half a teaspoonful to one or more a month.

At a year old, a child may have a small tablespoonful twice a day. It would not be wise to use the juice of very sour fruits, such as lemon, in large quantities or continuously. Where the daily use of fruit juice is not convenient it may be given once or twice a week with advantage. Where fruit is not obtainable, the juice of raw carrots or potatoes may be used. They should not be peeled, but should be properly cleansed and kept in boiling water for a few seconds before pressing out the juice, so as to prevent giving the baby any living germs from the soil. They may be grated and squeezed through muslin, or may be cut up and pressed in a lemon-squeezer. The juice should be strained carefully before use and diluted as in the case of fruit juice.

Barley jelly. (1) Soak four level tablespoonfuls (or three ounces) of well-washed pearl barley in a quart of warm water for an hour. Boil, then keep just about the boil for three hours. While hot, strain through clean muslim or mulmul into a scalded jug. Cover loosely, cool rapidly in running water, keep in a cool airy safe. Make fresh every day. (2) Rub *two* level tablespoonfuls of Robinson's barley into a paste with cold water and make up to ¾ pint by stirring in boiling water. Boil gently for half an hour and make up at the end of that time to ¾ pint.

N.B.—When using jelly for the first time (say at nine months), begin with barley jelly, because oat jelly is more apt to irritate the bowels.

Rice jelly. Proceed as for barley jelly — using *whole rice.* Rice jelly is preferable to barley jelly if the bowels are relaxed. Oat jelly is the most laxative.

Rice-water or barley-water may be made, by using six times as much water as for preparing jelly; or, by adding five parts of boiling water to one of the prepared jelly.

Wheat or oat jelly. Proceed as for barley jelly, using oatmeal or soji instead of barley flour. After fifteen months of age, if the baby has good digestion, use a coarser strainer. Thin ordinary gruels can be made by using about half the proportion of meal given in the above recipes.

Limewater. Thoroughly stir one tablespoonful of freshly-slaked lime into half a gallon of boiled water; cover to keep out falling particles. After twelve hours pour off the water and throw it away, as it contains any impurities present. A thick cream of lime will remain at the bottom of the vessel. Again add ½ gallon of boiled water, stir for three minutes and allow it to stand, covered as before, for twelve hours. The clear fluid is limewater and should be carefully poured off and bottled for future use. It will keep if the bottles are filled and well corked. Green glass-stoppered bottles are best, corked with sound, well-cleansed corks which have been scalded just before use. Limewater deteriorates in the presence of air; therefore, the bottles should not be larger than pints and the one in use should always be well corked immediately after pouring out. The exact quantity of lime is not important, provided sufficient is used, because water will only dissolve a certain quantity.

Many of the diseases observed in older children and adults begin in infancy.

Baby's first year. The food for the infant is practically

all milk and we should continue the milk as the child grows older as the main part of his diet.

Even breast-fed babies are better off if given about four masas (one teaspoonful) of orange juice, strained and mixed with a little warm water, once a day, when *four months* old. This can be gradually increased as baby gets older. Tomato juice, or carrot juice may be substituted.

Study the accompanying schedule and you will see that when baby is *five months* old we begin to give him about four masas of cooked soji, put through fine mulmul and added to one of his feedings. This, too, is increased as he grows older, but it must be very gradually done, until he will be getting a tola of cooked soji by the time he is seven months old. Read up the rule for cooking the soji. Other finely-ground grains may be substituted.

When baby is *six months* old, we can begin to give him the *juice* of poi, alu, ghola, methi, ambadi, tandulja or gajra, cooked in a small amount of water and the juice squeezed through mulmul. Begin with four masas, and by the time he is eight months old he will be taking one tola.

When *eight months* old, baby can be given a bit of stale chappatti, phulka, rotli, toasted until hard, or rotli toasted *dry*. Unless it is very hard and dry, it will not serve its purpose of giving baby something to bite against and develop his teeth.

By the time baby is *nine months* old he can begin to take milk from a cup and the vegetables can be sifted through a coarser mesh so as to allow some of the pulp to go through. Other vegetables, *plainly boiled* (with *no spice*, *curry stuff*, *chilli*, *ghee*, etc.), may be strained and given, gradually.

When baby is *ten months* old, he will be taking some of the milk in a cup, some he can eat with the strained cereal porridge (see recipe), and some he may take with the strained vegetable. Remember on no account to give highly-seasoned vegetable to a small child.

During the *tenth* and *eleventh months* the weaning should take place.

The following is a practical plan for weaning after *nine months :*

1. Give wheat, oat or barley jelly by spoon at 10 a.m. Begin with one tablespoonful of the jelly and give two or three teaspoonfuls of cows' milk on it. Follow this by the usual breast-feed, and give breast-feeds as usual for the remainder of the day.

2. Give at 10 a.m. wheat, oat or barley jelly, which may be gradually increased to three or four tablespoonfuls, and follow this by 6 oz. to 8 oz. of humanized milk. Omit breast-feeding.

3. Give breast-feed at 6 a.m., 2 p.m. and 10 p.m. At 10 a.m. and 6 p.m. give wheat, oat or barley jelly, followed by humanized milk, as above.

4. Give breast-feed at 6 a.m. and 6 p.m. At 10 a.m., 2 p.m. and 10 p.m. give humanized milk mixture. Give wheat, barley or oat jelly at 10 a.m. before bottle, and at 6 p.m., before breast-feed.

5. Give breast-feed at 6 a.m. only—humanized milk at all other feeds—wheat, barley or oat jelly before 10 a.m. and 6 p.m. feeds.

6. Discontinue giving breast-feed at 6 a.m., and give humanized milk, 8 oz., instead.

The baby is now entirely weaned.

If the mother's breasts become uncomfortable or painful during the process of weaning baby, consult the doctor or nurse immediately—*do not delay.*

Give baby the best opportunity for health by the formation of good food habits and tastes.

(*Note.* The change from complete natural feeding to complete artificial feeding should never be made in less than two weeks, except for urgent reasons—preferably take five or six weeks. Avoid weaning in very hot weather, if possible.)

Baby's second year. The time after baby is weaned and begins to eat other foods is the most important in his life for acquiring right habits. It is also the most dangerous time, for his digestion can be so easily upset. We must be very cautious how we add foods to his diet and try only one new food at a time and just a tiny bit at that. When you find the food is agreeing with him, still be careful not to make him dislike it by giving too much or too often.

Regularity as to his food is of the greatest importance. Four meals a day are required during this year. The following is a good time-table to follow: At 6 a.m., 10 a.m., 2 p.m., 6 p.m. Give just a cup of warm milk for the early morning feeding, and give only water between meals, except that once a day a tola of orange or tomato juice may be added to the water.

When baby is a year old, he should be entirely weaned from the bottle and taught to drink from a cup. He may have cooked cereal grains twice a day. These, such as soji or rawa, oatmeal or pounded rice, should be *cooked thoroughly* in water for a long time and strained through a fine sieve or mulmul, until baby is fifteen months old at least.

He should have two seers of milk daily, diluted one part of boiled water to three parts of whole milk.

Two seers of milk will only furnish about 600 calories, and as the baby grows older we must begin carefully to add other foods to provide the necessary heat and energy. Baby is active and uses up a great deal of fuel in proportion to his size.

When fifteen months old, he may be given half a tola of thoroughly cooked dhal, strained and not seasoned with anything but a little salt. Or he may have the yolk of an egg.

The juice of most fresh fruits may be given him after he is a year old; and after he is eighteen months old he may

have fruits such as apple or apricot, cooked and strained. But be very careful not to give fruit that is old or over-ripe, or that has stood uncovered in the bazaar where the flies could walk over it.

When eighteen months old, he can have a little potato and half a tola of any other fresh green vegetable, if they are well cooked in water, without spice, chilli, phodni or masala. Season only with salt and put a little ghee or butter on, after they have been cooked and strained, but *never fry* the vegetables which are to be given to young children.

Baby should be given stale, dry, toasted bread, rotli or chappatti, with butter or ghee.

Never give tea, wine, beer, soda-water, sweet balls or other sweets, nor opium.

Baby's third year. When baby reaches his third year, three meals a day are sufficient.

Breakfast. The juice of a sweet lime, orange or mango, or the pulp of stewed fruit, such as apricots, mango or apple. Either a well-cooked cereal, such as oatmeal, maize meal, soji, rice, salted and with four masas (a teaspoonful) of sugar, eaten with milk; or a tola of well-cooked dhal; or a soft cooked egg; with *stale* bread, rotli or chappatti toasted dry. A cup of milk.

Dinner. A choice of broth or soup, thickened with rice, barley or dhal. Vegetables cooked in the broth or in a small amount of water and strained; or white meat of chicken or boiled fish. Vegetables, potato and one other, such as beans, gavar, chauli, poi, methi, peas, spinach, etc. The vegetables are to be thoroughly cooked in water (without masala or ghee or phodni) and mashed. Stale or dry bread, rotli, toasted and eaten with ghee or butter.

Supper. Well-cooked cereal, roti or rotli, milk, stewed fruit.

Foods to be avoided: (1) Meats—corned or dried meat,

sweet breads, ham, pork, sausages, meat stews, dressings from roasted meats. (2) Vegetables—fried, of all varieties, highly seasoned with phodni or masala. (3) Green maize, cucumber (kakadi), radish (mula), cabbage, etc. (4) Breads and cakes—fresh made chappatti or bread, with butter or ghee added while hot, sweet cakes or pastries. (5) Dessert —candy, sweets, jelabi, ladu, burfee, nuts, chutneys, koshimbeer. (6) Drinks—tea, soda-water, or alcohol.

Children under twelve years. The source of fuel and building material for the body of children under twelve is the same as that of the small child, but the proportion of milk gradually changes until milk provides only one-half and then one-third of the calories. The big danger is that we may reduce it still further by substituting the grains or meat too rapidly and in too high a proportion.

The scarcity of milk, its uncleanness and expense make the provision of milk in the diet of older children a great problem for those with small incomes. It is one of the problems you are going to try and solve when you get older. For the present it is suggested that you try using good, dried whole milk. It is certainly clean, though it may be expensive.

Fruits and vegetables must be increased in the diet as the proportion of milk is lessened, to provide the required minerals and vitamins. Dishes which combine fruit and milk, or vegetables and milk are excellent. From the recipes, make a list of those that would fulfil this object.

Children should not be given vegetables fried and highly seasoned with phodni and masala.

Grains may be cooked with milk. See recipes of this kind and write in your note-books as many as you can think of. The grains need not be strained as the children get older, but should be simply and thoroughly cooked.

Protein will be provided by the vegetables, cereals, milk and pulses, and for some by eggs. A little meat is

allowable from seven years on, but in a hot climate it is better to use eggs and milk than meat for children. If meat is given, then one to two tolas is all that should be permitted. Fish is preferable to meat for children.

How shall we plan the meals for these boys and girls? Three meals a day is the right number and the food might be distributed as follows:

Breakfast. Fruit, boiled grains served as porridge with milk, and milk to drink. Toasted bread or chappatti, with a little butter or ghee.

Dinner. This meal may consist of unpolished bhat, dhal, koshimbeer of methi, or other raw vegetable or fruit (not highly seasoned), lime juice, vegetable cooked simply and served with ghee. Milk to drink, dudpak or shrikhand, made without much seasoning. Lapsi or rabidi are suitable.

Or the main meal may be a potato baked in its jacket and eaten with butter and salt, another vegetable, simply cooked and seasoned; an egg, or a little fish or meat. A raw salad, or at least a little raw vegetable, such as tomato, cabbage, or even a little grated carrot; a simple milk pudding with fruit, or fruit with milk to drink.

Supper. This may be rabadi or lapsi, toasted chappatti, fruit, and milk to drink; or a vegetable soup, made with water in which the vegetables were boiled, and milk, thickened with soji or barley; or a vegetable baked custard, with toasted bread; or a soft cooked egg, with a baked potato, or rice; or milk toast, or porridge and milk.

With these should be given milk to drink; fruit, stewed; and toasted bread.

Try making out meals for your small sisters and brothers, according to the foods which you commonly enjoy. The meals will differ according to your race habits, but, by substituting dishes to which you are accustomed for those which are similar, you can make a menu which will be suitable and appetizing.

At birth, a European baby weighs approximately seven pounds and an Indian baby weighs on an average five and three-quarter pounds. From this tiny beginning the baby must develop to twenty or twenty-five times his weight, if he grows to be a man. From the diagram you will notice that the most rapid growth of a child is in the first year. A baby doubles his weight in six months and trebles it in a year, then his growth becomes slower. Look again at the diagram and see when growth again becomes rapid. Between ten and sixteen years of age, boys and girls increase rapidly in weight if they are provided with adequate food. From this we conclude that one of the factors which determines the amount of food needed is *age*.

There is some difference, you will notice, in the time when greatest growth takes place for boys and girls. Boys, too, are usually larger than girls. For these and some other reasons, we say that *size* is a factor governing the food requirement. If we know the height and weight of a person, it helps us to determine how much food one requires for health and growth. A tall, thin girl needs more fuel to keep her warm than a short, broad girl of the same weight, because she has more body surface for the radiation of body heat. Her heart has to pump the blood a greater distance and, therefore, more energy is required.

From the charts (Figs. 154 and 155) you will see that during adolescence boys and girls both grow much more rapidly than at any time after their first year.

What should *your weight* be according to your height? Let us consult the following tables (Figs. 156 and 157) and see whether for your height and age you are the right average weight. If you are not, then perhaps you can correct the fault. We are first concerned with the question of how much food we require to provide for heat and energy for the body needs.

With the charts and the tables you can approximate

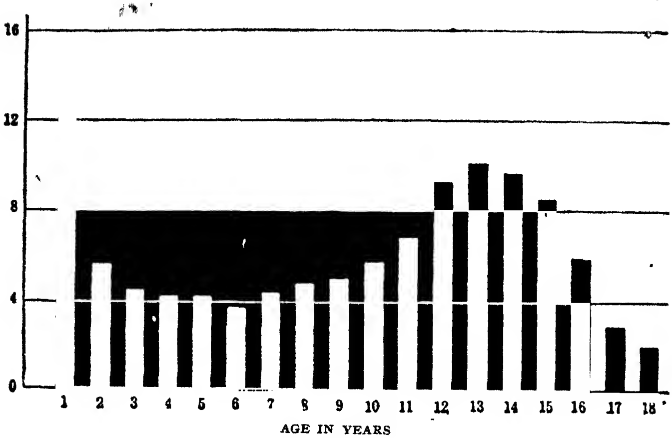

Fig. 154
Increase per year in the weight of girls
(Dietetic Bureau, Boston, Mass.)

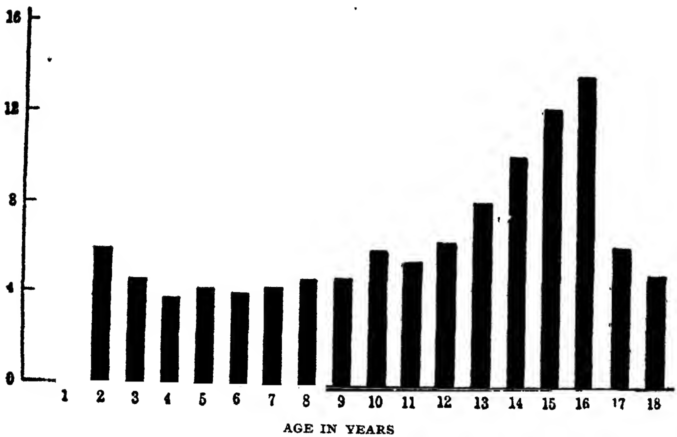

Fig. 155
Increase per year in the weight of boys
(Dietetic Bureau, Boston, Mass.)

HEIGHT AND WEIGHT (lb.) TABLE FOR GIRLS

Prepared by Dr. Thomas D. Wood

Height Inches	5 Yrs.	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs.	11 Yrs.	12 Yrs.	13 Yrs.	14 Yrs.	15 Yrs.	16 Yrs.	17 Yrs.	18 Yrs.
39	34	35	36											
40	36	37	38											
41	38	39	40											
42	40	41	42	43										
43	42	42	43	44										
44	44	45	45	46										
45	46	47	47	48	49									
46	48	48	49	50	51									
47	...	49	50	51	52	53								
48	...	51	52	53	54	55	56							
49	...	53	54	55	56	57	58							
50	...	...	56	57	58	59	60	61						
51	...	...	59	60	61	62	63	64						
52	...	...	62	63	64	65	66	67						
53	...	...	...	66	67	68	68	69	70					
54	...	...	...	68	69	70	71	72	73					
55	...	...	...	...	72	73	74	75	76	77				
56	...	...	...	...	76	77	78	79	80	81				
57	...	...	...	...	...	81	82	83	84	85	86			
58	...	...	...	...	...	85	86	87	88	89	90	91		
59	...	...	...	...	...	89	90	91	93	94	95	96	98	
60	...	...	...	...	...	...	94	95	97	99	100	102	104	106
61	...	...	...	...	...	...	99	101	102	104	106	108	109	111
62	...	...	...	...	...	...	104	106	107	109	111	113	114	115
63	...	...	...	...	...	...	109	111	112	113	115	117	118	119
64	...	...	...	...	...	...	...	115	117	118	119	120	121	122
65	...	...	...	...	...	...	...	117	119	120	122	123	124	125
66	...	...	...	...	...	...	...	119	121	122	124	126	127	128
67	...	...	...	...	...	...	...	...	124	126	127	128	129	130
68	...	...	...	...	...	...	...	...	126	128	130	132	133	134
69	...	...	...	...	...	...	...	...	129	131	133	135	136	137
70	...	...	...	...	...	...	...	...	...	134	136	138	139	140
71	...	...	...	...	...	...	...	...	...	138	140	142	143	144
72	...	...	...	...	...	...	...	...	...	...	145	147	148	149

About what a girl should gain each month

Age 5 to 8................	6 oz.	Age 14 to 16................	8 oz.
,, 8 to 11................	8 oz.	,, 16 to 18................	4 oz.
,, 11 to 14................	12 oz.		

Try and do as much better than the average as you can.

Weights and measures should be taken without shoes and in only the usual indoor clothes.

Girls' chart.—Fig. 156

(By Child Health Organization, 1918.)

HEIGHT AND WEIGHT (lb.) TABLE FOR BOYS

Prepared by Dr. Thomas D. Wood

Height Inches	5 Yrs.	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs.	11 Yrs.	12 Yrs.	13 Yrs.	14 Yrs.	15 Yrs.	16 Yrs.	17 Yrs.	18 Yrs.
39	35	36	37											
40	37	38	39											
41	39	40	41											
42	41	42	43	44										
43	43	44	45	46										
44	45	46	46	47										
45	47	47	48	48	49									
46	48	49	50	50	51									
47	...	51	52	52	53	54								
48	...	53	54	55	55	56	57							
49	...	55	56	57	58	58	59							
50	...	...	58	59	60	60	61	62						
51	...	...	60	61	62	63	64	65						
52	...	...	62	63	64	65	67	68						
53	...	...	...	66	67	68	69	70	71					
54	...	...	...	69	70	71	72	73	74					
55	...	...	...	...	73	74	75	76	77	78				
56	...	...	...	...	77	78	79	80	81	82				
57	...	...	...	...	...	81	82	83	84	85	86			
58	...	...	...	...	...	84	85	86	87	88	90	91		
59	...	...	...	...	...	87	88	89	90	92	94	96	97	
60	...	...	...	...	...	91	92	93	94	97	99	101	102	
61	...	...	...	...	...	...	95	97	90	102	104	106	108	110
62	...	...	...	...	...	...	100	102	104	106	109	111	113	116
63	...	...	...	...	...	...	105	107	109	111	114	115	117	119
64	...	...	...	...	...	...	...	113	115	117	118	119	120	122
65	...	...	...	...	...	...	...	...	120	122	123	124	125	126
66	...	...	...	...	...	...	...	...	125	126	127	128	129	130
67	...	...	...	...	...	...	...	...	130	131	132	133	134	135
68	...	...	...	...	...	...	...	...	134	135	136	137	138	139
69	...	...	...	...	...	...	...	...	138	139	140	141	142	143
70	...	...	...	...	...	...	...	...	...	142	144	145	146	147
71	...	...	...	...	...	...	...	...	...	147	149	150	151	152
72	...	...	...	...	...	...	...	...	...	152	154	155	156	157
73	...	...	...	...	...	...	...	...	...	157	159	160	161	162
74	...	...	...	...	...	...	...	...	...	162	164	165	166	167
75	...	...	...	...	...	...	...	...	...	...	169	170	171	172
76	...	...	...	...	...	...	...	...	...	...	174	175	176	177

About what a boy should gain each month

Age 5 to 8	6 oz.	Age 12 to 16	16 oz.
,, 8 to 12	8 oz.	,, 16 to 18	8 oz.

Boys' chart.—Fig. 157

(By Child Health Organization, 1918.)

what your normal height and weight should be, according to your age.

Find your height in the first column and your age in the cross column. Lay a ruler along the line opposite your height and where it coincides with the age column the figures will indicate what your weight *should* be. Is your weight in accordance with this?

Record heights, ages and weights of all in your family. If the teacher will collect this data, we will soon be able to work out tables for Indian people, and not be compelled to use Western tables. According to the author's experience in Gujarat, the average size of individuals is as follows:

Sex	Age—years	Eastern people		Western people	
		Height	Weight lbs.	Height	Weight lbs.
Man	25–30	5′ 3″	125	5′ 8″	154
Woman ...	18–25	4′ 11″	95·5	5′ 3″	122
Girl	14–17	4′ 8″	89	5′	111
Girl	10–13	4′ 5″	62	4′ 8″	74
Boy	1 year	...	15	...	21

Compare this table with your own findings and complete it by adding the height and weight for those of different ages.

Food required for heat and energy. We have learned that our requirement for fuel food is controlled to a certain extent by our *age* and *size*. Another important factor in determining how much food we require is our *activity*. The more active we are, the greater the amount of fuel (food) we need to provide that energy.

We are now prepared to determine *how much* fuel in the form of food a person needs.

You must know that the body must have fuel at all times, even while sleeping. When lying quietly in bed for

twenty-four hours, a man would burn 168 calories for every stone weight of his body, or 7 calories per hour. If he weighs 10 stone, he will require 70 calories per hour, or 1,680 calories of heat in the twenty-four hours, just to keep his body warm and alive, though he himself is lying still. The fuel requirements of men, women and children have been determined by scientists, so that now we are able to tell, according to our *age*, *height*, *weight* and *activity*, how much food we each need.

You will say that all men do not weigh the same and that is true. But you can take proportionately less or more, according to weight, for a smaller or larger man doing the same work.

Approximate averages of the energy expenditure per hour, under differing conditions of activity, of the average sized man in Baroda, weighing 55 kilograms (121 lb.):

Sleeping	50–55	calories per hour
Awake, lying still	55–70	do.
Sitting at rest	80	do.
Standing at rest	90	do.
Tailoring (darzie)	105	do.
Typewriting, rapidly	110	do.
Bookbinding	135	do.
Light exercise	135	do.
Shoe-making (mochi)	140	do.
Walking slowly (about 2¾ miles per hour) ...	160	do.
Carpentering	190	do.
Active exercise	230	do.
Walking rapidly (about 3¾ miles per hour)	235	do.
Stone-working	315	do.
Severe exercise	355	do.
Sawing wood	380	do.
Running (5¾ miles per hour)	395	do.
Very severe exercise	470	do.

Note.—Based upon figures given by Dr. H. C. Sherman, in his work *Chemistry of Food and Nutrition*, p. 186. Dr. Sherman has given the averages for a man weighing 11 stone (154 lb.), and we have arbitrarily assumed that a smaller man will require less in exact

proportion. This is the nearest we can arrive at our requirements, in the absence of exact calorimeter experiments in India.

From this table you can plan how much a man would use in one day, according to his work. Take, for example, the class teacher. He would require food to provide energy as follows:

Sleeping—8 hours	8 x 55 =	440 calories
Sitting at meals—2 hours...	2 x 80 =	160 ,,
Sitting in the classroom—4 hours	4 x 90 =	360 ,,
Walking leisurely about classroom—3 hours	3 x 160 =	480 ,,
Walking briskly to and from school—1 hour	1 x 235 =	235 ,,
Working in the garden—2 hours	2 x 230 =	460 ,,
Reading at night—3 hours	3 x 90 =	270 ,,
Dressing, bathing, etc.—1 hour	1 x 135 =	135 ,,
		2,540 calories

Food required for growth and repair of body tissues. You have already learned what foods will provide heat and energy to meet the needs of your family. What are they? We must now consider the body's requirement of food for *growth and repair of tissues.* These foods we have called 'building materials'. It has been proved that an adult needs to have from 75 to 100 grams (masas) of *protein* per day. Sometimes we measure this in terms of the percentage of total calories in the diet. If you select 12 per cent to 15 per cent of the calories from protein, the body will have a sufficient supply. The other building materials needed are the *mineral salts*, and the amount needed has been estimated also. From what source will you secure these materials? We cannot measure the amount of *vitamins* needed in grams, but we can see that the foods containing all these vitamins are included in our diet. What are they called? Where are they most plentifully found?

If food is in the right proportion it should provide:

Protein	75 to 100 grams
Fats	52 to 90 ,,
Carbohydrates ...	350 to 450 ,,

Calcium	... ...	·68 to 1·00 gram
Phosphorus	... ...	1·00 to 1·32 grams
Iron ...	... ...	·015 to .02 ,,
Vitamins	... ...	A, B, C, D, E.

We must now consider from what sources we will select our daily diet in order to meet these requirements.

Determine the amount of energy *you* require, according to the hours spent sleeping, sitting, walking, standing, doing housework, and so forth.

Calculate the amount your father and mother, sisters and brothers require and record in your note-books.

Compare your results with those found by other girls in your class. Discuss the differences.

Let us imagine that our family consists of a father, mother, a girl of fourteen years, a boy of eight years and a baby only one year old. How many calories will they require?

Persons composing family	Minimum requirement calories	Maximum requirement calories
Adult man ...	2,500	3,000
Adult woman ...	1,730	2,380
Girl of 14 years ...	1,840	2,390
Boy of 8 years ...	1,700	2,100
Baby of 1 year ...	900	1,000
Total calories required	8,670	10,870

This is the amount of food the family of five will need for one day. To determine their requirement of calories for a week, multiply the amount for one day by seven. This brings us a total of 76,090 calories. Study the following groups of foods and see what proportion from each we will select the fuel for our family.

$\frac{3}{10}$	fuel, or 24,000	calories, supplied	from seed grains	by	14½. lb.
⅕	,, ,, 16,000	,, ,,	,, milk ,,	,,	28 ,,
			and dhal, meat, eggs	,,	10½ ,,
⅕	,, ,, 16,000	,, ,,	from fats, oils and from fat foods	,,	5 ,,

$\frac{1}{10}$ fuel, or	8,000	calories, supplied	from sugar and sweet foods	,,	4½ lb.
⅛ ,, ,,	16,000	,, ,,	from fresh fruits and vegetables	,,	70 ,,
Total .	80,000	calories from all sources			132¼ lb.

Note.—Adopted from U.S. Dept. of Ag. Bulletin, No. 1313: Caroline L. Hunt, *Good Proportions in the Diet.*

Groups of foods

(1) *Seed grains, or cereals* (*corn*). From these our breads are made. The more economical our diet must be, the larger the return in *calories* we shall secure for our money if we buy this group of foods. If we use the *whole* grains we shall get more calcium, phosphorus and iron than if we use the polished rice and patent white flour. Even so, we cannot get all the mineral salts we require. These foods are also low in vitamins A and C. The proteins are *not all complete* and need to be supplemented.

(2) *Milk and its products* (*curds or cheese*). From milk we secure calories for heat and energy, *complete protein* for tissue building, mineral salts and vitamins. Taken with pulses and grains, it supplements their deficiencies.

(3) *Pulses, or legumes* (*dhal*). These, like the cereal grains, furnish energy as well as protein. Some of their proteins are *incomplete*. They contain minerals and some vitamins. Sprouted pulses are higher in vitamins.

(4) *Eggs*. The yolk of the egg especially is rich in minerals and vitamins. The whole egg is rich in *complete* protein, and is a good source of energy because of its fat. Eggs can, therefore, supplement the protein of the grains and pulses.

(5) *Meats, poultry and fish*. These are rich in *complete* proteins and fat. They yield energy, but are deficient in minerals and vitamins. They can be used in place of the grains, but they need to be supplemented in a similar way. Are they as cheap as the grains?

(6) *Fats and sugar.* They provide heat and energy, and are chiefly added to the diet to increase the calories. You will remember that butter and ghee also provide vitamin A. They contain *no* protein.

(7) *Fruits and fresh vegetables.* They provide some calories. They are important sources of *complete* protein of mineral salts and vitamins. This is, therefore, a good group of foods to supplement the grains and pulses.

Marketing. You had better begin by making a price list of the cost of foods that you require.

Make a list of the ghee, oil, sugar, etc., according to the cost per seer, or the amount you can purchase for one rupee. Do not forget the milk, nuts, spices, vegetables and fruits. From the food composition lists you can easily calculate how much the calories are going to cost and which are the most economical sources of heat and energy. You will discover that a thousand calories in the form of rice may cost as little as one anna, while in the form of ghee it will cost five annas and three pies, while in the form of milk it will cost five annas and nine pies, and vegetables will cost six annas and four pies per thousand calories.

Can we let the cost control our choice entirely? Supposing you bought only rice, would the food be sufficient to keep you well and make you grow? No, we have to remember all the time that we need not only calories of heat and energy, but protein, mineral salts and vitamins.

See if you can plan a good way of spending the money you have for food. When you have determined the amount to be spent for each class of foods, we will try making up the menu for the day's meals.

Let us begin by determining how much we need of the cereal grains for the whole family. Write this down in seers and calories also. These we will call Group 1.

Next let us calculate how much milk we shall have to buy. The baby and all the little children must have two

seers each. The older ones should really have as much, but if we cannot afford it, we will allow them one and a half seers each. All the others in the family should have a seer of milk daily. Now add this up and calculate how many calories the milk will furnish. Call this Group 2.

Group 3 will consist of all the foods which we must buy for the special purpose of providing proteins, such as the pulses (dhal), eggs, cheese, fish, flesh or fowl. Estimate how many calories you will secure from this group of foods.

How much ghee, butter and oil will you need for the whole family? This will be less in quantity, but high in calories. Write down the amount and mark it Group 4.

Group 5 will be all the sweets you require, in whatever form—shakker, gul, etc.—for everyone in the family for the day. Calculate the weight and the calories.

The sixth and last group will contain all the fruits and fresh vegetables of all sorts and kinds. This *ought* to be a much larger amount than is usually planned for.

Count up the calories from each group separately, and let us consider whether your choice has been wise and good. Do you know how to estimate percentage? We want to know what part of the calories each group will furnish in the family diet.

First we must know what the grand total of calories amounts to, so add all the calories of the six groups together. Compare this with the total requirement of our imaginary family at the beginning of this chapter. Let us suppose you have 8,000 calories in all for the daily diet of the whole family. Divide the total into the number of calories from each group. Be sure to get your decimal point in the right place. The answer will be the *percentage* of the whole. After you have worked out the percentage supplied by each group, compare it with the standards of eastern and western diets on p. 327.

Such a diet as we have selected should be better in its proportions than the ones shown on p. 331. Next you will have to determine its cost. This is where we find ourselves in difficulty. You may have to change your marketing list if the expense is greater than you can afford. You will notice we have not counted in the cost of the chilli, spices and other condiments, nor of tea. When these are added in, you will see what part of the whole they cost and can tell whether we are in the habit of spending too much just for flavours which do not give us energy or material for growth.

Of course, we shall not always go through such calculations as these when marketing for the family, but if we work it out here in class, we shall better understand what we are really purchasing with our money.

Here are two diets which have been calculated to show how the percentage of the money set aside for food has been proportioned. Do your diets correspond to these?

Foods	*Percentage of money* spent by *vegetarian* for foods	*Percentage of money* spent for *mixed* diet
Group 1, cereals	32 per cent	28 per cent
Group 2, milk	20	14
Group 3, proteins	11 (dhal)	18 (mixed)
Group 4, sugar and spice ...	10	9
Group 5, fats	20	20
Group 6, vegetables	7	11
	100	100

(Proportions suggested by Miss Gillett, in America.)

The following table might help us to make some general rules for those using a *mixed diet*:

Divide up your food *money* into five parts. Spend

One-fifth, or less, for vegetables and fruits.

One-fifth, or more, for milk and cheese (curds, mawa, etc.).

One-fifth, or less, for meats, fish and eggs.

One-fifth, or more, for bread and cereals.

One-fifth, or less, for fats, sugar, and other groceries such as spices, etc.

See if you can make a good rule for the division of your money in buying food for a *vegetarian* diet.

The vegetarian spends about—

$\frac{3}{10}$ths of his money for cereals.
$\frac{1}{5}$th ,, ,, milk,
$\frac{1}{10}$th ,, ,, pulses.
$\frac{1}{5}$th ,, ,, fats.
$\frac{1}{10}$th ,, ,, sweets and spices.
$\frac{1}{10}$th ,, ,, vegetables and fruit.

The man who eats the mixed diet has to pay more for his proteins, so he spends less on milk and cereals and buys more vegetables. Don't you think the vegetarian would do better to buy more vegetables and less sweets? The less we have to spend the larger the proportion of our money that must be spent for cereals, but we should be careful not to try to save on the milk and vegetables. We could do without the fats and sweets better. *What do we get* for our money when marketing for the family?

Class of Foods	European		Hindu	
	Low cost % of total calories	High cost % of total calories	Low cost % of total calories	High cost % of total calories
1. Foods from cereal grains ...	40 %	20 %	·80 %	·53 %
2. Foods from milk	18	16	·03	·08
3. Protein foods (from mixed sources) ...	8	16	·09	·18 dhal
4. Fats and oils ...	12	18	·04	·12
5. Sugars ...	10	10	·02	·06
6. Vegetables and fruits ...	12	20	·02	·03
Total cost ...			Rs. 7-10-4	Rs. 10-12-9

For percentage distribution of calories of low and high cost, *European*[1] diet compared with Indian diet, see table at foot of p. 327.

The *low cost Hindu diet* is taken from the actual budgets of 78 individuals, composing average families of 4 persons. The average family income, was Rs. 50 (well above the average income for most families). The average monthly expenditure for food per head was Rs. 7-10-4, or about four annas per day.

It is surprising that, on what is called a 'vegetarian' diet, so few vegetables are used. Vegetarian diets really mean foods from other than animal source. We should make them more representative of their name by using more *fresh vegetables*, and growing them, if necessary.

The *high cost Hindu diet* percentages[2] are worked out from the following dietary (p. 331), which is superior to the average diet among Indian people. It provides all the essentials in protein, fats, carbohydrates and minerals.

You will notice that most of the protein is from vegetable sources. We have already learned that at least one-third of the protein should come from milk and its products such as curds and cheese, or from eggs, meat or fish, or leafy vegetables, because these proteins are *complete*. The proportion of protein from milk is less than one-fifth in this diet. If a larger amount of green leaf vegetables were used, it would help to make up for the lack of animal protein. One good point in the diet is that the cereals are varied and not all of one kind. If whole wheat flour, atta, unpolished natural rice and a variety of pulses (dhals) are used, it would improve the diet. The fat in this diet is about equally divided between that from animal sources, milk and ghee, and that from vegetable sources, oil, nuts, etc. This is as it should be.

The small amount of vegetables is the worst point in this

[1] Dr. Mary Swartz Rose, *The Foundations of Nutrition*, p. 385.

[2] The cost is less than six annas per day per head.

diet. You should have twice as much vegetables as are here provided.

Dr. Robert McCarrison[1] recommends that one-third the protein and half the fat should come from animal sources, and that vegetables used in the diet should weigh four times more than meat and dhal.

Cereal	Seers per month	Foods in Hindu high cost diet					Calcium gram per day	Phosphorus gram per day	Iron gram per day
		Minimum cost per month	Maximum cost per month	Grams per day	Calories per day	Protein gram per day			
		Rs. A. P.	Rs. A. P.						
Rice ...	15	1 11 0	2 13 0	226·8	797	16·5	·020	218	·002
Wheat ...	8	0 14 6	1 6 6	120·8	422	16·3	·054	·511	·006
Bajri ...	8	0 10 6	0 11 3	120·9	439	12·5	·017	·395	...
Milk ...	22½	2 4 0	2 13 0	340·1	237	11·22	·408	·316	·001
Vegetables	15	0 15 0	0 15 0	226·8	90	3·63	·365	·349	·008
Chilli ...	·25	0 0 9	0 0 9	3·7	14	·35	...	...	...
Ghee ...	1·5	2 3 0	2 3 0	22·7	204	...	...	...	...
Coconut	·5	0 2 6	0 2 6	7·5	46	·43	·004	·012	...
Oil ...	1	0 8 0	0 9 3	15·1	136	...	...	...	...
Sugar ...	2	0 12 6	0 12 6	30·2	121	...	...	...	...
Molasses ...	1	0 3 0	0 3 0	15·1	43	·36	·032	·007	·001
Tur	5	0 14 0	1 0 0	75·6	270	16·8	·01406	·596	·012
Groundnut	·5	0 2 0	0 2 0	7·5	46	1·44	·005	·030	·0001
Other pulses ...	4	0 8 0	0 8 9	60·5	212	13·8	...	...	...
Other spices ...	...	0 4 0	0 6 0	...	...	...	...	...	...
Total per day ...		...	...	...	3077	93·33	·9196	2·434	·0301
Standard per day		...	...	...	3000	75·0	·67	1·32	·015

Can you tell in what particular this diet differs from western diet? Since the proteins are chiefly from vegetable sources, the proportion should be higher though it appears to be about the standard requirement. Look up the vitamin

[1] Dr. R. McCarrison, *Food*.

content of the foods included in this diet from the accompanying list, and see whether you do not think more milk and leafy or fresh vegetables are required in proportion to cereal grains, to supply sufficient vitamins.

VITAMINS IN SOME COMMON FOODS

Foods	A	B	C
Nuts	x	x x	...
Milk	x x x	x x	x
Oil	?	...	...
Ghee	x x x	...	...
Sugar	...	...	...
Rice—brown	x	x x	...
„ white	...	...	...
Wheat	x	x x	...
Bajri	x	x x	...
Pulses	x	x x	x x
„ sprouted	x	x x	...
Meat	x	x x	...
Eggs	x x x	x x	...
Molasses	...	x	...
Fruit (oranges, lemons)	x	x x	x x x
Vegetables	x x	x	x
Tomato	x x	x x	x x x
Lettuce	x	x x	x x x
Spinach	x x x	x x x	x x x
Knol kol	...	...	x
Peas (fresh)	x x	x x	x x x
Potato	x	x x	x x
Sweet potato	x x	x x	x x
Pumpkin	x	x	x

Note.—The signs are meant to denote:

A little vitamin present ... x
A fair amount ... ... x x
A large amount ... ... x x x

When the food contains no vitamins, it is marked .... The question mark indicates that it has not been proved to be present.

Another diet, averaged from actual budgets of ten Baroda families (where the income averaged Rs. 70, and the number

in the family averaged 3·2), shows an equal expenditure of money (Rs. 10-10-0 per month) and a poorer proportion of foods:

FOOD VALUE OF THE FOOD PURCHASED IN TEN HINDU FAMILIES

Food	Percentage expended for total calories	Quantity per month (seers)	Quantity per day (grams)	Protein		Iron: grams	Phosphorus: grams	Calcium: grams
				Calories per day	Grams per day			
Milk	·05%	15	227	157	7·5	·0005	·21	·27
Oil	·09%	1 1/40	16	144	...	...	...	...
Ghee		7/10	14	126	...	...	...	...
Tea	...	1/8	2	...	...	...	...	...
Condiments	...	7/20	5	...	...	...	...	...
Sugar	·03%	1 3/8	24	96	...	...	...	...
Molasses	...	2/8	6	16	·13	·0004	·0024	·012
Vegetable	·02%	11 1/7	166	66	3·4	·0023	·10	·11
Rice	·70%	18 1/8	272	944	21·42	·0025	·25	·01
Wheat		9	136	474	17·21	·0066	·56	·06
Bajri		11 1/2	168	600	20·16	...	·55	·024
Pulses		5 5/8	85	300	22·11	·9974	·38	·093
Meat and Eggs	·11%	1 1/10	17	43	2·37	·0003	·0255	·0028
Total per day ...		... Calories		2966	94·3	1·0100	2·0779	·5818
Standard per day		... Calories		2500	75·0	·015	1·32	·67

In this diet you can plainly see the choice is too heavily given to the food grains or cereals. The vegetables and fruits, milk and fats, are too low. Look up the vitamin content of this diet and see what is wrong with it. Do you think this would affect the growth and health of the children? The *calcium* is dangerously low. What foods would you select to supply more calcium?

Boys and girls do not eat the same amount of food, because the boys are usually bigger and far more active than girls and may require a third more calories; but both

boys and girls should use more milk in proportion to cereal grains than adults use. Can you explain why? It would be wise to provide as many calories in the form of milk as of the grains. If you can afford it, you should also secure more calories from fats and fresh vegetables than adults do. Dried fruits and nuts help to give good building material.

PERCENTAGE OF CALORIES PER DAY FOR HIGH SCHOOL GIRLS

Class of foods	Recommended for mixed diet[1]	Possible modification for India
1. Cereals (food grains) ...	17	25 to 30
2. Milk and curds ...	25	15 to 20
3. Proteins (dhals or meat)...	10	10 to 12
4. Fats and oils	18	13 to 18
5. Sugar and dried fruit ...	10	9 to 10
6. Fresh vegetables and fruit	20	15 to 20

Compare your diet with this table, and see how nearly you approach these proportions.

In India, we may probably use more cereals than is here advocated; but we should try not to reduce the milk and vegetables.

Mixed diet in India. There are some races of Indian people who use fish, flesh and fowl for food, as well as eggs. It would be a good plan if the girls belonging to each racial group would work on their own diet especially. It is not expected that you will study so carefully the diets of the other groups. It is interesting to see, however, how similar the diets are in the essential factors.

On the whole, western methods of cookery are simpler than Indian, and probably the use of meat gives zest to a meal which the Indian supplies by spices and chillies. With a mixed diet, it is not wise or necessary to use much masala.

[1] Dr. Mary Swartz Rose, *Foundations of Nutrition.*

It must not be forgotten that when meat is used, there must also be milk or green vegetables and raw fruit to supply vitamins A and C and calcium.

How shall we divide our meals?

When early morning exercise is taken, something in the way of food is desirable and, therefore, the habit of chota hazri has developed. Also, as the best time for exercise in the afternoon is about sundown, afternoon tea is often wanted. Both of these meals are very light, consisting of a beverage, bread and butter and some sweet.

The main meals are breakfast or tiffin, at about 10.30 or 11 a.m., and dinner in the cool of the evening, about 8 or 8.30 p.m.

It is the Indian custom to take most of the food at one meal and that in the middle of the day. This custom is being modified in the big cities, where hours of business make such an arrangement of meals impossible. It is certainly best for the body to receive nourishment more frequently and less at one time. The plan of having chota hazri soon after arising and then tiffin about noon, with supper in the evening, is a good one; better, indeed, than the customary two meals of the Hindu, or the Anglo-Indian habit of having food too frequently: chota hazri, hazri, tiffin, afternoon tea, dinner, and supper. Such practice is not advisable, as it gives the digestive organs no rest.

Little children should have their meals served separately, as elsewhere discussed. They must have their porridge breakfast and their evening meal earlier than their elders.

The necessity of carefully supervising the eating habits of young children favours this separation of their meals and thus allows the mother opportunity to train her children to like the right foods and to eat them in the right way. This calls for patience, but it will well reward the mother when her children develop in health and strength.

Food for invalids, like that for children, must be selected from such sources as can be easily digested and will furnish an adequate amount of tissue-building materials and builders, i.e. protein, mineral salts and vitamins. If the disease is a 'wasting' one, the tissues will need an abundant supply of new material. That is why, in tubercular troubles, milk, eggs, meat, fruits and leafy vegetables are given in large amounts. These foods are good for all sick people, if the method of preparation is simple. We may classify the diets into four groups:

(1) Liquid diet as usually prescribed by the physician who will list the foods permitted to the invalid. Commonly they are broths, vegetable or meat extract, tea, milk and butter-milk, gruel, egg-milk drink, cream, soups, cocoa.

(2) Semi-liquid diet includes jellies, made with gelatin or Irish moss, meat jellies, custards, kanji, cereal jelly, strained vegetable pulp, milk, toast. One should secure definite directions from the doctor as to what foods he would permit.

(3) Soft diet is similar to the semi-liquid, but not strained. Additional dishes of chicken, fish, milk puddings, stewed fruit and creamed dishes may be added.

(4) Solid diet includes any food simply prepared which is easily digested. This permits of more variety in the method of cooking and serving the same foods. Among the recipes which follow, certain ones are marked as suitable for invalids.

The service of meals for the sick and convalescent should be always *punctual*, both for the good of their health and their state of mind. If the meals are planned ahead, you need have no trouble in serving the food without delay. The tray should be daintily and *attractively* set up, and the amount of food of the right quantity, so that they may feel free to eat all that is served. See that food which should be hot *is* hot, and that which should be cold *is* cold.

The accompanying table will help you to select your foods wisely.

'SELECT YOUR FOODS WISELY'

Food	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Iodine	Vitamins		
								A	B	C
Apples	...	...	G	...	...	...	...	F	F	F
Asparagus	F	...	G	F	G	...	G	G	G	...
Beans, string (french) ...	G	...	G	F	F	G-E	G	G	G	G
Bread, wholemeal (atta chapatti)	F	...	E	...	F	F	...	F	F	...
Butter or ghee	...	E	...	...	...	...	...	E	...	...
Butter substitutes (peanut butter)...	...	E	...	...	...	...	...	...	...	...
Cabbage, raw	...	...	F	F	...	G	G	F	E	E
Cabbage, cooked	...	...	F	F	...	G	G	...	G	G
Carrots	...	...	G	G	...	G	...	G	G	G
Cauliflower	...	...	F	E	E	...	G	F	G	F
Celery stalks	F	...	F	G	G	F	F	...	...	...
Cereals, dry (food grains, whole)...	F	...	E	...	F	F	...	...	G	...
Cheese	E	E	...	E	G	...	G	G	...	...
Cream	...	E	...	...	...	...	...	E	G	F
Eggs	E	E	...	F	G	E	E	G	F	...
Fish	E	F-G	...	...	G	...	E	...	...	...
Figs (dry)	...	...	...	G	F	G	...	...	...	...
Honey	...	...	E	...	...	...	...	...	...	...
Jam	...	...	E	...	...	...	...	...	...	...
Lettuce	...	...	...	G	G	...	G	G	G	E
Marmalade	...	...	E	...	...	...	...	...	...	...
Meat	E	F-G	...	...	G	F	...	...	G	...
Milk	G	E	G	E	G	F	E	E	G	F
Nuts	G	G	...	G	G	...	...	...	...	...
Oranges	...	...	G	...	...	...	...	F	G	E
Peas	G	...	G	F	F	G	...	G	G	...
Potatoes	...	...	E	F	...	F	...	...	F	F
Prunes	...	...	G	F	...	F	...	G	G	...
Rice (polished)	...	...	E	...	...	...	...	...	...	...
Rolled oats	F	...	E	F	F	...	...	...	F	...
Spinach	...	...	E	G	E	E	G	E	F	F
Sugar	...	...	E	...	...	...	...	...	...	...
Tomatoes	...	...	F	F	F	G	?	G	E	E

E = Excellent. G = Good. F = Fair.

Let us remember that: (1) *protein* is material for tissue-building and repair, (2) *minerals* are also materials for tissue, bones, teeth, and blood, (3) *carbohydrate*, *fat* and *protein* are energy or fuel foods, and *vitamins* are necessary for growth and health. They are very likely to be low or lacking in diets.

A *balanced diet* must include all the food elements in the right proportions to meet nutritive requirements. Study the table and select the most valuable foods in planning your diet.

Whole cereals of one kind and another, wheat, bajri, and rice, with milk and its products, dhal, fresh fruits and green leafy vegetables, will provide an adequate diet for all your needs.

Most of us become aware of our need for food because of the promptings of hunger and we allow our appetites to determine what foods and how much we shall eat. Unfortunately, appetite is not always a safe guide, as poor physique and vitality testify. By studying nutrition we can make more intelligent selection of our foods and thus increase our strength and improve our health. In later chapters we shall consider the methods by which foods should be prepared and cooked to retain or increase their nutritive value.

AGENDA

Oral and Practical

1. When and why should a baby be given hard toast to munch?
2. Why is nursing better for a baby than bottle-feeding?
3. How long should a baby be nursed?
4. What is the difference between mothers' milk and that of the cow or goat?
5. How can you determine the amount of water to add to cows' milk when giving it to a baby?
6. Why should orange and tomato juice be given to a baby? When and how would you give it?
7. What precautions must be taken in preparing and keeping the humanized milk?

8. What bottles would you select? How care for them and the nipples?

9. At what age is cereal jelly added to a baby's diet?

10. How may a baby be best weaned?

11. How can right food habits be established for life?

12. What foods may a child have in his second year, in his third year?

13. What foods should we avoid giving a young child?

14. How much of the diet of a ten-year-old child should consist of milk? What should be given to provide the remainder of his food?

15. At what ages does the greatest growth take place?

16. Are you the right weight for your age and size?

17. What are the factors which determine the amount of food you need?

18. What are the chief characteristics of each group of foodstuffs from which we select our diet?

19. How much of the money set aside to buy food should we spend for each group of foodstuffs?

20. What are the chief faults in your diet? How can they be corrected?

21. How are your meals divided?

Exercise 13

1. Using cows' milk, prepare the food for a baby, six months old, for half the required number of feedings per day. Why is it best to prepare only half the day's food at a time in India?

2. Prepare one feeding of goats' milk for a baby, three months old. Which milk is best to use?

3. Prepare cereal jelly from barley, unpolished rice or oats.

4. Prepare limewater.

5. Cook spinach and put through mulmul as for a nine months old child.

6. Prepare a day's food for children, one year old and two years old.

7. Plan the meals for a child under twelve years of age. If possible, prepare and serve them.

8. How many hours do you spend sleeping and working, etc.? Plan your daily requirement of calories according to your activity.

9. Plan an adequate diet for yourself.

10. Determine the quantity of food required by your family per week to supply all their needs.

11. Work out its cost.

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CHAPTER XIV

METHODS OF COOKERY: STARCHES, VEGETABLES AND FRUIT

'Delicious foods were spread and dewy fruits,
Sherbets new chilled with snows from Himalay,
And sweetmeats made of subtle daintiness,
With sweet tree-milk in its own ivory cup.'

—*Sir Edwin Arnold.*

Required.—The heating apparatus, cooking utensils and food materials mentioned in the text.

Note. The simple recipes given in the following chapters require only vegetarian food materials and milk and its products. Recipes for additional vegetarian dishes, and for dishes requiring the use of eggs, fish or meat, are given in the Appendix.

Each student should prepare at least two kinds of each of the following: bread, cake, protein dish, vegetable, rice dish, milk dish, sweetmeat, etc., according to the custom of her community.

Methods of Cookery

Flavour of food. 'The science of cookery may be said to be in retaining all the nutrients and rendering the food more digestible. The art of cookery lies in producing flavours, textures and form which please the eye and the taste. The appetizing odour and pleasant flavour have a stimulating effect upon the digestive juices also. Indeed, there is more science in the production of flavours which 'make the mouth water' than is realized. Delicate chemical changes are responsible for the development of the aroma and flavour

which take place during the processes of cooking. And it is the need for developing good judgment and skill in this art which makes training in cookery so important.'

In India we have developed elaborate processes for the preparation of foods quite unknown in the west. The flavours are piquant and a source of unusual delight. The taste that is developed naturally in the food and a delicate bouquet of flavours added skilfully should be our aim.

When spices and condiments are added in too great amount, they deaden our sense of taste and weaken our digestion as well. We whip up the taste by adding more and more, causing the digestive secretions to flow from the glands until they tire and refuse to respond, just as the ghariwala, who whips his horse too much, finally discovers that the horse pays no attention to the whip.

Most flavours are really odours, and we all know the delight of the attar of roses added to the pullao. The cardamom, jeera, etc., each have their individual taste and stimulate the appetite. But if we are to be artists in cooking, we will not add all our seasonings to everything and make them all taste alike. Neither will we add so much of these strong condiments and spices that the natural flavour of the food is entirely lost.

The fact that rice has so little flavour of its own and that our vegetables are very mild in natural savour, as well as the loss of appetite in hot weather, probably accounts for our habit of seasoning the vegetables so highly with chilli, masala and phodni. Those who take animal food should not be tempted to over-seasoning, as the flavour of meats is in itself stimulating. Don't you think we might try to make our dishes more individually distinctive? If you consider the recipes for preparing vegetables, you will find they are all seasoned in much the same way, and with so many spices, that they all taste alike.

Little children should *not* be given chilli and spice *at all*, and we should all have better digestions if we used less.

The art of cookery is one which is interesting to most girls and very necessary for all home-makers. Even if we do not do the cooking ourselves, we need to know how, if we expect the cook to carry out our instructions. The cook very soon discovers whether the mistress of the house understands the art. You have all probably had training in cookery at home and will be wondering what they can teach you in school that you do not already know. We hope to teach you the *whys* of cookery, and this it is which makes the work far more fascinating. You have learned the values of all the various food materials; now we will observe the changes which take place when they are cooked.

METHODS OF COOKING

1. *Grilling*:	Cooking over a glowing fire	Direct application of heat
2. *Roasting*:	Cooking before a glowing fire (toasting)	
3. *Baking*:	Cooking in an oven	Application by means of heated air
4. *Boiling*:	Cooking in boiling water	Heat applied by means of water
5. *Stewing*:	Cooking for a long time in water below the boiling point	
6. *Steaming*:	(*a*) Moist—cooking in steamer	By contact with steam
	(*b*) Dry—cooking in double boiler, or in a chatti set inside another chatti containing water	By the heat of steam surrounding vessel
7. *Frying*:	Cooking in hot fat, deep enough to cover the article to be cooked	Heat applied by means of heated fat
8. *Sautéing*:	Cooking in a small quantity of hot fat	
9. *Pan-broiling*: *Pan-baking*:	Cooking in a frying pan or on a griddle, with little or no fat	Heat applied by means of heated metal
10. *Braising*:	A combination of stewing and baking	
11. *Fricasséeing*:	A combination of frying and stewing	

In cooking, we should weigh the materials required in the preparation of a dish of food. Often, instead of troubling to weigh, we 'guess' and 'use our judgment'. If we wish to be excellent cooks we must be *accurate* in our work.

In our practical cookery work, it would be a wise plan for us to begin by weighing and measuring the various materials commonly used in the kitchen.

Make a table showing the comparative weights and measures. Then you will be able to measure the materials in the small or large spoon or in a cup. The accompanying table is based upon the liquid measure known as the *imperial quart.* A quart measure will hold 40 fluid ounces (oz.) or 2 pints (pts.). See if this table will be of use to you:

3 large tsp.	(teaspoonfuls)	make	1 tbsp. (tablespoonful)
20 tbsp.	(tablespoonfuls)	,,	1 c. (cupful)
2 c.	(cupfuls)	,,	1 pt. (pint)
2 pts.	(pints)	,,	1 qt. (quart)

We have already learned that 2½ tolas make one ounce, so you can readily estimate that:

1 qt. is equivalent to 100 tolas
1 pt. ,, ,, ,, 50 ,, etc.

Measure some of the foods and see if the accompanying table is fairly correct. If you do not have the teaspoon, tablespoon, cup, pint and quart measures, then *use the measures you do have* and *work out a table for yourself.*

Table of measurement

½ tsp. sugar		= 1 masa
1 ,, flour		
⅝ tbsp. ghee or oil		= 1 tola
1 ,, rice or sugar		
1⅓ ,, soji or rawa		
2 ,, atta or maida		

1½ c. of milk		= 1 seer
1⅗ ,,	ghee or oil	
2 ,,	sugar or gul	
2 ,,	rice	
2¼ ,,	dhal	
2½ ,,	soji	
2⅔ ,,	icing sugar	
4 (scant) c. of atta (flour)		
4 level c. of maida (flour)		
10 to 12 eggs		

Item	Masa	Tbsp.	Tola	C.	Seer	Pint
Sugar, white and brown, or gul	12	1	1	...	...	...
	240	20	20	1	½	½
	480	40	40	2	1	1
Sifted maida (atta, scant measure)	12	2	1	...	...	...
	240	20	10	1	¼	½
	960	80	40	4	1	2
Ghee and oil	12	⅚	1	...	...	...
	240	16	20	1	½	½
	480	32	40	1⅗	1	1
Milk	12	⅘	1	...	...	...
	240	16	20	¾	½	⅜
	480	32	40	1½	1	¾

Make measurements *level*. This is done by filling the spoon or cup lightly with dry material, and levelling off the top with a knife. Do not pack the material into the cup. To measure butter or ghee a spoon or cup must be filled solidly. To measure a part of a cupful of any fat, put water into a cup, leaving unfilled that portion of the cup which you desire to measure for the butter or ghee. When you put the butter into the cup of water, you measure by displacement and avoid having the measure made greasy.

Liquids are measured to fill a spoon or cup as full as it will hold. The accompanying picture shows the regulation sized cup and spoon (Fig. 158).

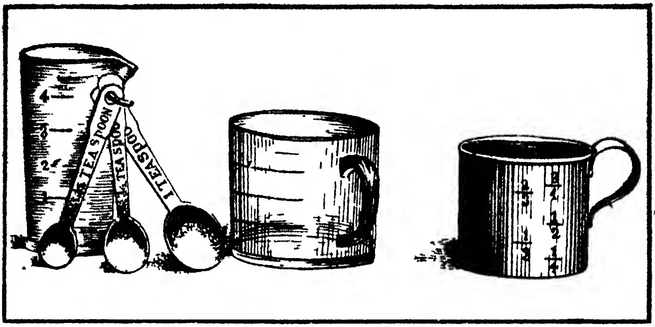


Fig. 158
Everyday kitchen measures
(Courtesy of Bureau of Standards, Washington, D C)

Before beginning to cook, see that you have everything required. The right tools and utensils, and your materials weighed or measured or ground, as the case may be. Have your fire lighted, or ready to light, so that once beginning the process of cooking you will not have to stop to search for anything needed.

TEMPERATURES FOR COOKING

For baking: paper test. It is the right temperature for placing food into the oven when a piece of white paper, placed in the centre of the oven, browns in the time specified in table at head of p. 345, for each food.

For deep fat frying: bread test. Temperature of the fat is correct for frying when a small piece of white bread, dropped into fat, browns in the time specified below for each food.

Food	*Bread test*
Croquettes	40 seconds
Fritters, bhajias	30 seconds
Fish	60 seconds
Doughnuts	60 seconds
French Fried Potatoes	20 seconds

Cooking with fats. Fats, as you know, are made of the

Food	Time for cooking per lb.	Oven temperature	Paper test for temperature
White bread (yeast) ...	60 min.	Hot[1]	2 min.
White bread (baking powder)	60 min.	mod.	3 min.
Scones	10–15 min.	very hot	1½ min.
Cup cakes	20–25 min.	very hot	1½ min.
Layer cakes	15–20 min.	hot	2 min.
Loaf cakes	45–50 min.	mod.	2½ min.
Biscuits	10–15 min.	hot	2 min.
Sponge cake	40–50 min.	very mod.	3½ min.
Custards	60 min.	slow	4 min.
Pastry shells	10–15 min.	very hot	1½ min.
Pie	30–40 min.	very hot[1]	1½ min.
Meat and poultry ...	20–25 min.	very hot[1]	1½ min.

[1] Reduce the temperature for the last half of cooking.

same elements as carbohydrates (look this up on the chart), but they differ from starch and sugar in the *proportion* of oxygen to carbon and hydrogen. As there is much less oxygen in the fats, they must take more from the air for their oxidization. Therefore the fats will yield *more than twice as much heat* as the carbohydrates yield. People in cold climates, therefore, should eat more fat than people in hot climates. The digestion of fats is chiefly by a process of emulsion, and when we heat them, we make them less digestible than when they are uncooked. Fats may be heated above the boiling point of water without showing any change; but if raised to too high a point a slight decomposition takes place, and products are formed which irritate the mucous membranes and interfere with digestion. You know how your eyes and throat are irritated with frying foods in fat, and it is these substances, produced by the high temperature, which make fatty foods and foods cooked in fat indigestible.

Furthermore, we must not overlook the fact that, by heating butter and ghee in open vessels for frying, we destroy much of the vitamin A.

All of these factors should, therefore, lead us to employ other methods of cooking than frying *wherever possible*, and to use the oil for salad koshimbeers, and ghee for seasoning vegetables after they are cooked, and for eating upon bread, instead of frying our foods so much and so often.

For sugar syrups : cold water test. Cook syrup until it reaches a stage indicated below. Test by dropping a small amount of the syrup into cold water.

Candy	In cold water test syrup will make a
Fudge and sweet palas	Soft ball
Fondant	Soft ball
Caramels and toffee	Hard ball
Peanut brittle	Caramel or crack

Principles of Cookery Applied to the Essential Constituents of Our Diet

I. *Carbohydrates*

1. *Sugars.* (1) Cane sugar, fruit sugars, honey, treacle, etc. (2) *Reasons for cooking.* To improve the flavour of other foods, and to change cane sugar to simpler form. (3) *Effect of cooking.* Cane sugar is a double sugar, and when heated with water it is hydrolized and changed to dextrose and levulose, simple sugars more readily absorbed. (4) *Method of cooking.* With water at a high temperature, sometimes with addition of acid, or it may be made into a syrup by heat.

2. *Starches and cellulose.* (1) These are found in vegetables and cereals. (2) *Reasons for cooking.* To soften the cellulose and make the starch more digestible and appetising. (3) *Effect of cooking.* When the cellulose of starchy foods is heated in the presence of moisture, the cellulose is softened and the grains swell and burst the cellulose envelope, making it easier for the digestive

juices to penetrate the food. This requires a high temperature, and if much cellulose is present a long time should be given to the process of cooking. The starch is then hydrolized and changed to a simpler form more easily digested. Starch may be made into a gummy liquid by the application of dry heat. (4) *Method of cooking.* Some vegetables contain sufficient water in their composition to make it possible for them to be cooked in the oven by dry heat. This method insures the retention of all the nutrients. Vegetables and cereals are most frequently cooked with water at a high temperature, continued for longer or shorter time, according to the fineness of the cereal and size of the vegetable. A fireless cooker is convenient for long process cookery.

II. *Proteins*

1. (1) *Group of foods of animal origin.* Meat, fish, eggs, milk, cheese. (2) *Reasons for cooking.* The digestibility of these foods is *not* increased by cooking. Heat is applied to render them more appetising in appearance and taste. (3) *Method of cooking.* Heat has the effect upon protein of making it solid it at a low temperature. If heat is applied at a high temperature and for a long time, it will render the protein hard and indigestible. (4) *Method of cooking.* Apply heat at a low temperature for as short a time as is compatible with the development of flavour, colour and texture.

2. (1) *Proteins of vegetable origin.* Beans, peas, lentils, cereals. (2) *Reasons for cooking.* Some vegetable proteins require cooking to develop them. They are combined with starch and cellulose, both of which require long cooking at a high temperature. (3) *Effect of cooking.* Heat develops vegetable proteins, softens cellulose and swells starch grains, rendering them all more digestible. (4) *Method of cooking.* Moist heat, high temperature and long cooking are necessary to make these foods palatable and digestible. Use fireless or pressure cooker.

III. *Mineral elements, ash constituents and vitamins*

(1) The class of foods in which these constituents predominate are the fruits and vegetables of the juicy or succulent variety. Milk is also a good source of vitamins and minerals. (2) *Reasons for cooking.* To sterilize; for variety; to soften cellulose; from habit. (3) *Effect of cooking.* If long continued will largely destroy the vitamins. Heat does not affect the minerals. If soaked or cooked in water, much of these constituents pass out into the water and may be wasted. Soda destroys vitamins. (4) *Method of cooking.* Eat uncooked as far as possible. Wash vegetables in running water, and keep in damp butter muslin. Never soak. Cook in as little water as possible, at high temperature, for a short time. Never add soda.

IV. *Fats and oils*

These are more easily digested uncooked and, if necessary to heat them, they should not be brought to a high temperature, as the heat disintegrates the fat. Frying foods in fats of any kind is the worst possible method of cooking. In so cooking the foods we make it difficult for the digestive juices to penetrate, and thus delay digestion. We frequently overheat protein foods by cooking them in fat. Frying food is the habit of a thoughtless housewife. Fats are much better used to season cooked foods, and oils to dress salads. *Cookery of starchy foods.* You have already learned that starches, sugars and cellulose are formed by plants from carbon dioxide (CO_2) and water (H_2O); and you have tested with iodine various cereals and vegetables to determine the presence of starch.

Is starch soluble in water? We found that in boiling water it formed a transparent jelly. The starch grains are enclosed in an envelope of woody fibre, called cellulose. This is softened by *boiling* water, and the swelling starch is able to burst the cell walls.

We know that food materials must be changed to a

soluble form before they can pass through the walls of the digestive tract. Therefore, starch must be changed to a soluble form before we can assimilate it. Cane sugar, too, must be changed to a simpler form before being absorbed. The simple sugars found in fruits can be absorbed without change, and therefore require no cooking. This accounts for the fact that raisins, dates, figs, and such dried fruits, are so easily digested.

Starch, however, must be *chemically* changed. By thorough mastication it is possible to partially bring this change about; and we eat some foods containing raw starch, such as plantains. Raw starch requires a much longer time to digest than cooked starch, and that is why civilized people use heat, water, acid, or ferments to partially *hydrolize* the starch before eating it.

Starch first takes up water, and if acid or a ferment is present the change to simple sugar is hastened. In bread-making, the *yeast* breaks up the sugar into CO_2 and alcohol. If the alcohol is burned, then the carbohydrate is changed to CO_2 and H_2O again. So that the starch and sugar is returned to the air in its original form from which the plants first made it.

If starch is heated dry it will change to *dextrin*, which is soluble in cold water. If you continue to heat it, it will be further changed to *caramel*, which causes its brown colour. Test with iodine. When heated still more it turns black. What is this?

The *simple cooking of starch*, as we find it in rice, soji and potato, consists in softening the cellulose with moisture and heat. The starch grains are capable of swelling to twenty-five times their bulk. When so distended it is much easier for the digestive juices to penetrate the mass, and change it to its simpler form for use in the body.

From the accompanying diagram (Figs. 159 to 161) you can see the effect of cooking potato. A similar change takes place when we cook rice,

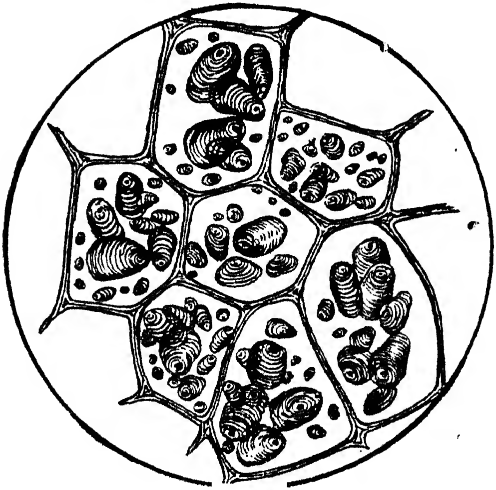


Fig. 159
Cells of a raw potato, with unruptured starch grains and cellulose framework
(From *Food and Dietetics*, by Dr. Robert Hutchison. William Wood & Co., New York.)

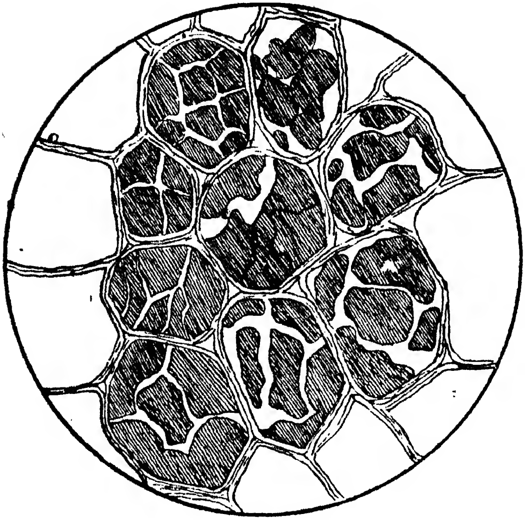


Fig. 160
Cells of a partially cooked potato, the starch grains ruptured
(From *Food and Dietetics*, by Dr. Robert Hutchison. William Wood & Co., New York.)

The potato contains so much water (Fig. 162) that it may be cooked without adding any more. A half seer weight of potato contains nearly a cupful of water. Rice and soji, on the other hand, require a great deal of water in cooking.

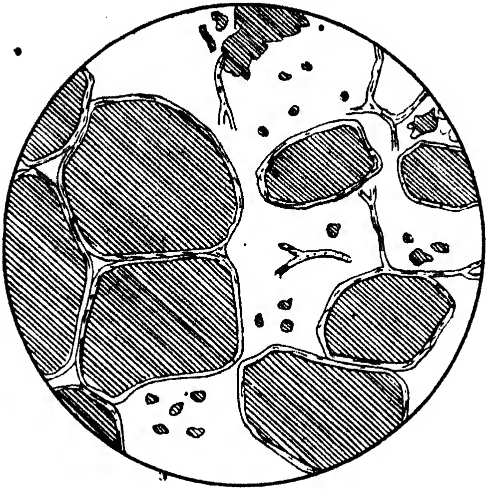


Fig. 161
Cells of a thoroughly boiled potato ; cellulose framework broken down
(From *Food and Dietetics*, by Dr. Robert Hutchison. William Wood & Co., New York.)

Exercise 14

1. Test various cereals—rice, wheat, bajri—cooked, moist and raw with iodine.
2. Wash a little rice, and test the water with iodine.
3. Collect a little saliva in test tubes. Add small amounts of cooked and uncooked cereal, let stand in warm water ten minutes. Test with iodine, and draw conclusions.
4. Compare the thickening qualities of various cereals, by cooking one tola of each in one cup of water for 15 minutes. How much water did you have to add to each to prevent it from burning? Which was cooked best? Record the amount of water required to cook each kind.

The Japanese have found that if the rice is washed before cooking there is such a great *loss of mineral salts and vitamins* so that they now advocate cooking rice *without washing it.* Of course, we must use the *unpolished* rice, and

Fig. 162

A half-pound potato contains nearly a tumblerful of water
(Courtesy of Dr. Mary S. Rose and the Macmillan Co., New York.)

we must not use any more water in cooking than the rice will absorb. Do not throw away any water in which rice has been cooked, but use it in sauces or soup.

Recipe 1. *Rice (bhat sadha) suitable for invalids*

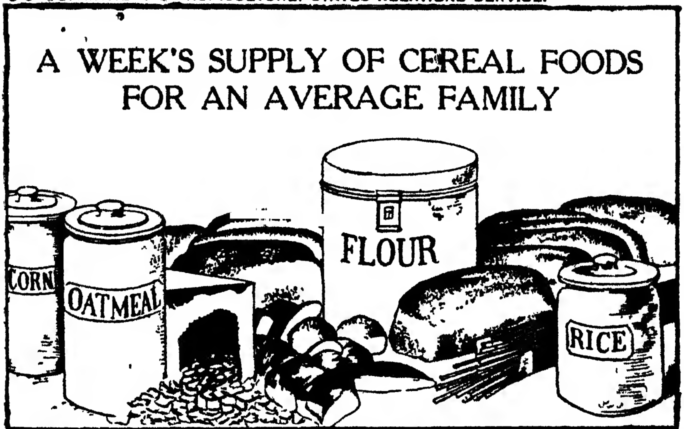
There are several methods of cooking rice, but the simplest way is as follows:

Rice	½ seer	..	Pick it over.
Water	1 seer	..	Freshly boiled. The amount of water will vary with the newness of the rice.
Salt	½ tsp.		Placed in the water.

Have water boiling in a tinned copper vessel on the chula, and add rice gradually so that the water will continue to boil. Reduce the heat, and cover the vessel with a lid. Let the rice steam for half an hour, lifting it occasionally to

see that it does not stick to the bottom. If the rice is old and dry, more water will be required. The rice may be steamed in a 'double boiler', that is, in a vessel standing inside another vessel of boiling water.' This prevents sticking or burning, but requires twice as long time to cook the rice.

FOOD SELECTION AND MEAL PLANNING. CHART NO. 4
U S DEPARTMENT OF AGRICULTURE. STATES RELATIONS SERVICE.



CONTRIBUTION FROM OFFICE OF HOME ECONOMICS C F LANGWORTH; CHIEF.
PREPARED BY CAROLINE L HUNT. SPECIALIST IN FOOD PREPARATION AND USE

Fig. 163

The total (bread, 10 lbs.; and dry cereals, 7½ lbs.) provides about 240 hundred calorie portions, or three-tenths the needed fuel. This proportion may be raised or lowered by half. Use whole grain products, if vegetables and fruits are scarce.

Recipe 2. *Boiled rice with coco-nut juice*

Rice	1 seer	Saffron	¼ tola
Coco-nuts	4	Sultanas	½ seer
Sugar	1 seer	Almonds	½ seer
Gul	1 seer	Ghee	½ seer

Method. Pick the rice over. Scrape off the kernel of four coco-nuts. Take out the juice and put the rice into a vessel with the juice on a moderate fire. When the rice has become a little soft, put it on a slow fire. When the coco-nut juice has almost dried up, take the gul, break it into pieces and, having mixed it with the sugar, put it into

rice with the saffron, almonds (blanched and broken into pieces) and sultanas. When the sugar and gul change into liquid-syrup keep simmering on a slow fire, till the liquid dries up. Continue adding a little ghee. When all the liquid is absorbed the rice may be served. This amount is sufficient for three persons.

Recipe 3. *Cereal porridge, suitable for children and invalids*

Cereal (oats, soji, etc.)	1 c.
Water	4 c.
Salt	½ tsp.

Boil the water, add salt and cereal gradually, keeping the water boiling briskly. Lift with a fork to prevent sticking, and cook directly over the flame for at least 10 minutes; cover, and place either in the fireless cooker or over boiling water, or on a slow fire. Let cook for from 1 to 3 hours, according to the coarseness of the grain. Sufficient water must be used in cooking cereals to swell the grains to their full extent, but avoid having the product too soft, as then it is liable to be swallowed without mastication. For young children, cereals should be strained through a mulmul bag or fine sieve, to remove all cellulose. When cooled, this gives a jelly.

Recipe 4. *Baked potato, suitable for children and invalids*

Do you know how to cook a potato without adding any water? Place hot ashes inside an oven pan, and lay potatoes or sweet potatoes, which have been nicely washed, on top of the ashes. Place the cover over the oven, and heap hot ashes or charcoal on top. It will require nearly an hour thoroughly to cook the potatoes, depending upon their size. They can be baked in a thoa closely covered, over a slow fire in the segri. If you have a stove or range with an oven, bake the potatoes in this. They require a hot oven. When done, squeeze them gently and with a fork break open the skin to let out the steam. They may be eaten, skins and all, either with salt alone or with butter or ghee.

Potatoes cooked in this way are good for little children and invalids as well as for the family.

Recipe 5. *Boiled potatoes*

The usual way of cooking potatoes is in water. Have a vessel of water boiling before placing the potatoes in it. It

is a good plan to add 2 or 3 masas of salt to the water. The potatoes may be boiled in their skins, or, if preferred, they may first be carefully peeled, so as to waste as little as possible. The former method is more economical, as the mineral salts lie close to the skin. Let the water cover the potatoes and boil them *gently* so that they may keep their shape.

To test whether they are done, prick with a fork. Then pour off the water into another chatti and keep it for soup. The potatoes should be dry and mealy, (i.e. crumbly on the surface) when done.

Methods of serving boiled potatoes. If they have been cooked in their skins, these must first be removed. Boiled potatoes may be mashed while hot, until free from lumps. Then add butter or ghee and hot milk enough to moisten, but not to make them too soft. Whip them vigorously with a fork until they are light. Add more salt if required, and whip until creamy. Then pile in a dish without smoothing the top. They should look like a mountain of snow.

Recipe 6. *Creamed potatoes: for children and invalids*

Cold potatoes may be re-heated in plain white sauce and seasoned with salt and pepper. The potatoes should be cut into small cubes and placed in the thickened sauce. Allow them to heat slowly, so that they may absorb the milk. This makes an excellent dish for children.

Batters and doughs. Bread and cakes are made with a foundation dough or batter, whose essential ingredients are flour, liquid of some kind, fat for shortening, salt, and some means of making the mixture light. To lighten or aerate the mixtures we use various means.

Air is used to lighten bread doughs, such as chapatti; and some batters, such as Yorkshire pudding. In the latter, however, as the batter is thin, and consequently insufficient in gluten to hold the air, it is customary to add eggs. The protein of the eggs will quickly harden and hold the mixture up, after the steam has expanded the mixture.

Bicarbonate of soda, in combination with sour milk or molasses (treacle) or lemon juice, may be used to lighten bread or cake, the amount of soda depending somewhat upon the acidity of the milk or molasses. The use of excess soda is a fairly common mistake, which makes the cake bitter to taste and more likely to fall and be soggy than to rise. One-half teaspoonful of bicarbonate of soda to one cupful of sour milk is considered a standard amount.

Baking powder, is a dry mixture of cream of tartar or tartaric acid and bicarbonate of soda, mixed with dry cornflour to prevent them from acting upon each other. Some baking powders use other acid constituents, such as acid phosphate. In using the baking powder it is wise to add it just before baking the mixture, or the carbon dioxide will escape too soon. When the mixture is placed in the oven or other hot medium, the gas expands, stretching the gluten of the flour. Further heating hardens the gluten, and the bread is made light and porous.

Recipe 7. *To make baking powder*

Cream of tartar	1 lb. and 2 oz.	Sift thoroughly together and keep in a closed bottle or tin
Bicarbonate of soda	½ lb.	
Cornflour	¼ lb.	

or, used without mixing :

Bicarbonate of soda	1 tsp.
Cream of tartar	2½ tsp.
Flour	1 seer

Yeast is another leavening agent. We have learned about yeast in Chapter I. When yeast is introduced into a dough it produces carbon dioxide. The heating of this during baking causes its expansion, and so the bread rises and is light. When the dough is baked the gluten hardens, thus holding the bread up.

German yeast may be procured from the baker, or made as follows :

Recipe 8. *Plantain yeast*

Take 2 over-ripe plantains, 2 tablespoonfuls each of sugar and flour, mix well with 6 tablespoonfuls of warm water, cork this liquid in a wide-mouthed bottle, and tie the cork down tightly. Shake the bottle occasionally. This yeast will be ready in thirty-six hours.

NOTE.—All measurements are made level.

Proportion of ingredients. There are four chief divisions into which batters and doughs can be grouped, as follows, according to the proportion of liquid that is used with flour. (1) *Pour batters* are thin enough to pour from the mixing spoon, and the proportion of liquid to flour is nearly even in *measurement.* One cupful of flour to one cupful of liquid, or half seer (lb.) of flour to one seer (lb.) liquid. (2) *Drop batters* are thick enough to drop from the mixing spoon. Their proportions approach that of two cupfuls of flour to one cupful liquid, or one seer of flour to one seer liquid. (3) *Soft doughs* have as much liquid combined with the flour as possible, but should still be able to be kneaded and handled on the board. Three cupfuls of flour to one cupful of liquid, or one and half seers flour to one seer liquid. (4) *Stiff doughs* have just as *little* liquid as you can manage to make the dough with and still be able to knead or roll it. Four cupfuls of flour to one cupful of liquid, or two seers of flour to one seer liquid. Remember that flour will weigh twice as light as liquid, so that, if you use weights instead of measures, you must adjust the proportions accordingly.

Exercise 15. Calculate the proportions of some common breads, and make a list of those which come under each heading. Compare on the constant basis of two cups (½ seer) of flour. Make a table for yourself of your results.

Quick breads: methods of mixing. There is a standard method of combining ingredients for each type of quick bread. Almost any kind of dough or batter can be mixed

according to one of these patterns — the batter way; the scone or pastry way; or the cake way. In all methods first measure all ingredients accurately.

1. The *batter method* is used mostly for batters, and consists of the following steps: (1) Sift together all dry ingredients. This includes salt, sugar, flour, baking powder or soda and spices. (2) Add liquid gradually, stirring until mixture is smooth. Liquid means milk, water, egg, molasses. The egg, if used, is beaten lightly into the other liquids. (3) Stir in melted fat.

2. The *scone or pastry method*, for doughs, both soft and stiff, is as follows: (1) Sift all dry materials together. (2) Cut shortening (i.e. the fat) into flour with knives, or mix it in coarsely with the finger tips. (3) Stir in gradually the liquid, adding just enough to give the dough the proper consistency.

3. The *cake method* of mixing is suggested for some particular quick bread recipes: (1) Cream the shortening and sugar. (2) Add the liquid ingredients. (3) Sift together, and add the dry ingredients.

Baking. Quick breads are baked immediately after mixing, either in a hot oven or on a hot griddle. Scones, gems, etc., need a hot oven temperature. The time of baking cannot be stated definitely, because of the widely varying size of loaves or scones, but in general baking is continued until the surface is golden brown in colour.

Recipe 9. *Chapatti or poli or rotli*

Atta or maida	½ seer ..	Sift twice with salt.
Salt	2 gunja ..	Add to centre of flour and mix.
Til (sesame oil)	2 tolas	
Water	½ seer ..	Combine with above to form a thick stiff dough.

Divide the dough into 10 small balls of equal size and roll 1 ball at a time into a thin cake. Fold it over and roll out again several times, and finally form into a very thin round cake (about 5″ in diameter). Place in a hot thoa

over a wood fire until it browns, then turn it and bake on the reverse side. It may then be thrown on to the hot coals to make it puff.

Chapattis should be cooked until crisp for *little* children, and allowed to cool before adding ghee.

Recipe 10. *Puri*

Coarse maida	½ seer	
Salt	1 gunja	.. Sift together twice.
Ghee	1 tola	.. Added for shortening.
Water or milk	¼ seer	.. Mix with above to form a stiff dough.

Allow the dough to stand for 10 minutes and then divide it into 25 equal balls. Roll them one at a time on a floured bread board into circles, 2½″ in diameter.

(By folding and refolding during the process, the dough is aerated into thin layers.)

Ghee	⅛ seer	.. Melt in a thoa and fry in it the small cakes until brown. They should puff up like small balloons, and be hollow inside.

Recipe 11. *Baking powder scones*

White flour	2 c.	Ghee	4 tbsp.
Baking powder	4 tsp.	Milk or water	¾ to 1 c.
Salt	1 tsp.		

Sift dry ingredients, rub in shortening with finger tips or cut in with two knives. Add liquid and mix to a soft dough. Toss on slightly floured board, pat into shape and cut with biscuit cutter. Bake 15 minutes in hot oven.

Recipe 12. *Soda scones*

Flour	2 c.	Thick sour milk or buttermilk	¾ c.
Soda	½ tsp.	Ghee	4 tbsp.
Salt	1 tsp.		

Sift together salt, soda and flour. Work in ghee. Add milk gradually, mixing to a stiff dough. It may not be necessary to use all the milk. Place on a floured board. Knead until smooth. Roll to one-half inch in thickness. Cut with a small round cutter and bake in a hot oven 12 to 15 minutes.

Variations

Bran. Substitute one and one-half cups bran for one cup wheat flour. Add jaggery or molasses if desired, one-quarter to one-half cup.

Whole wheat. Substitute one cup whole wheat for one cup flour.

Corn. Substitute three-quarters cup yellow cornmeal for one cup flour.

Cereal. Substitute cooked rice, oatmeal, or other cereal for part of the flour, one-third or one-quarter.

Recipe 13. *Bran brown bread*

Bran	1 c.	Sugar (moist brown)	½ c.
Sour milk	1 c.	Flour	1 c.
Raisins	½ c.	Soda	1 tsp.
Melted ghee	2 tbsp.	Salt	¼ tsp.

Mix together the bran, sour milk and raisins, then add the sugar and flour, which has been sifted with the soda and salt. Stir in the melted ghee. Put the mixture into a greased can, cover tightly, and steam for 3 hours.

Yeast bread: action of yeast in bread. You have already learned that yeast is a micro-organism, a tiny plant which reproduces itself by budding and by forming spores, which in turn become new plants. Under favourable conditions yeast cells multiply very rapidly, producing as they grow a gas, carbon dioxide. This process is called the fermentation process; the sugar is acted on by the yeast, and changes into alcohol and carbon dioxide. It is the gas which, forming all through the dough, stretches the cell walls and causes the bread to rise. During baking the gas expands, thus increasing the size of the loaf, before the dough is hardened by the heat and the gas driven off.

Three things are necessary for proper growth and development of the yeast plants: *warmth*, *moisture* and *food*. Yeast is killed by high temperatures and rendered inactive by low ones. The moisture present in the air is

usually sufficient in quantity to favour the growth of the yeast cells.

Yeast plants feed on sugars—on the sugar which is developed from the starch in the flour, if there is no other sugar present. Sugar, added to a yeast mixture, hastens and aids the fermentation.

Salt retards fermentation, and consequently should never be added to the yeast mixture until after it has had a good start.

The yeast cells are active, and need only to be separated with the water so that their distribution throughout the dough will be complete. A very little sugar added to the water will hasten the action of the yeast. After soaking, the yeast is stirred into a warm batter or sponge, where, under the influence of food and further moisture, it starts the fermentation process.

Methods of making bread. There are two general methods of preparing bread dough—the quick, short fermentation process, and the longer process. In the latter process, a sponge or batter is usually held over-night before it is made up into a stiff dough, while by the quick method the dough is made up immediately and baked within a few hours.

The principles involved in both of these methods are practically the same.

Cleanliness. Cleanliness is the first consideration. When the conditions under which bread is prepared are so favourable for the growth of bacteria, absolute cleanliness is necessary to prevent contamination of the dough by micro-organisms other than yeast.

Temperature. The temperature of the sponge or dough must not be allowed to fall low, and it should not be raised too high. A constant, even heat is desirable while the bread is rising.

Kneading. Kneading of the dough is an essential part of the bread-making process. It helps to distribute the

cells uniformly throughout the dough, so that the holes will be small and evenly spaced, instead of large in one part of the bread and small in another.

Kneading also develops the gluten in the flour, making the dough more tenacious, so that the gas bubbles forming throughout the dough can stretch it. By 'developing' the gluten is meant simply causing the particles to adhere by pressing them together, thus forming a continuous network or structure of gluten.

Gluten is an elastic material which composes practically all of the protein of the flour. It is directly responsible for the expansion of the dough, and for this reason the amount and quality of the gluten in flour is of great importance.

Hints for successful bread-making. Always sift flour before measuring, and measure accurately. Keep flour in a warm place for some time before using, so that it will not chill the dough. Scald milk, and cool before using. Never add water which is more than tepid to yeast. Do not allow dough to become chilled or overheated. Never try to hurry or force raising of dough, or, on the other hand, do not allow it to stand too long between kneadings. Do not add more flour during kneading than is absolutely necessary. Keep dough soft.

Recipe 14. *A good yeast bread*

Good dry flour	3½ lb.	Milk	1 seer
German yeast	1 oz.	Salt	2 tsp.
Sugar	2 tsp.		

Mix the salt with the flour and put it in a large pan, making a hole in the middle. Mix the yeast with the sugar, an equal quantity of flour and a little tepid water. Pour the mixture into the hole in the flour and sprinkle a little flour over it. Leave it for about 10 minutes. Then mix all together with the milk (warmed) and knead it well. Leave it for 2 hours in a warm place, put into tins and bake for three-quarters of an hour.

Cakes, biscuits and frostings: method of mixing. Cream the fat and sugar well together. Sift the baking powder,

salt and flour very thoroughly. A more thoroughly incorporated baking powder means a more even-textured cake. If the beaten white of the egg is to be folded in last, be sure that it is well mixed through the batter. When left in lumps, it destroys the even texture of the cake. When adding raisins, nuts, or dried fruit, have them dry on the surface and well dredged with flour to prevent bunching and sinking to the bottom. Melted chocolate is best added directly to the fat and sugar; it helps in the creaming process, and is more evenly distributed through the batter.

Baking. Grease the cake pans and sprinkle flour over the grease. This helps to remove the cake from the pan easily. Most failures in baking are due to the heat being *too great.* See that you have a *steady* heat, but *slow.* It may take longer, but your success is much more assured.

Tests. To know when a cake is done, watch the sides, and note when the cake begins to shrink from the pan; when that happens the cake is well baked.

Another test is to press lightly, with the finger tips, the surface of the cake. If it springs back it is surely done.

A third method is to test by piercing the cake with a fine straw or stiff stem of grass; if it comes out of the cake clean, with no cake adhering, the cake is baked.

Recipe 15. *Scotch short bread*

Maida flour	1 lb.	Butter	½ lb.
Sugar	¼ lb.		

Rub the butter and sugar to a cream, gradually add the flour, and knead well. The longer it is kneaded the better it is. Lay it on the board and press it with your hands into sheets half-inch thick, cut into even-sized pieces, and bake in a moderate oven.

Recipe 16. *Date cake*

Maida or atta	¾ lb.	Bicarbonate of soda	1 tsp.
Shortening	3 oz.	Vinegar	1 tsp.
Brown sugar	6 oz.	Salt	1 tsp.
Dates	4 oz.	Mixed spices	1 tsp.
		Milk	1 c.

Mix spice with the flour, rub in the shortening, chop dates, and roll in flour. Dissolve soda in a portion of the milk and combine with the dry ingredients, adding remainder of the milk (more if atta is used). Add the vinegar last. Put into a greased tin and bake in a moderate oven for 2 hours. This will keep well for several weeks.

Recipe 17. *Fruit cake*

Sugar	1 c.	Sour milk	1 c.
Butter	4 tbsp.	Raisins	1 c.
Flour	2 c.	Soda	1 tsp.
Salt	½ tsp.	Ground cinnamon	1 tsp.
Ground cloves	½ tsp.		

Method. Cream butter, add sugar, and stir until light. Mix and sift dry ingredients, and add to above alternately with the milk. Flour the raisins and add last. Put into a greased pan, and bake in a moderate oven for 30 minutes.

Pastry

Types of pie. (1) Covered; (2) uncovered; (3) tarts or turnovers.

Plain paste

Method of mixing. The fat is worked into the flour (which has been well sifted with the salt), either with the finger tips or with some convenient utensil. It is possible to use a fork for this purpose, or two knives cutting against each other. The important thing is to incorporate the fat into the flour without getting too dense a mixture. The fat should be allowed to remain in small lumps (one-eighth inch or less) throughout the flour. Perhaps knives accomplish this result better, because the heat from the finger tips warms the fat; but the latter method is quicker, especially if one is already accustomed to it, and almost equally satisfactory if a light touch is used.

Pastry. A cool, dry atmosphere is an essential condition for successful pastry making. Use maida, well dried. The shortening, is largely a matter of taste. Better results are secured with a fairly hard fat; therefore, if a softer fat is

used, it should be quite cold. Cold water is necessary in mixing the paste, and no more should be used than is absolutely necessary, as water detracts from the shortness of the crust. Cool hands and deft handling are important factors.

Recipe 18. *Plain pastry*

Flour	3 c.	Salt	$\frac{1}{2}$ tsp.
Shortening (butter or ghee)	$\frac{2}{3}$ c.	Water	$\frac{3}{8}$ to $\frac{3}{4}$ c.

Sift dry ingredients into chopping bowl. Cut in shortening. Add enough water gradually to make a paste which is not crumbly, but holds together without adhering to knife or bowl. Turn on to a board lightly dredged with flour, and roll out to thickness required. Do not allow paste to stick to board or roller.

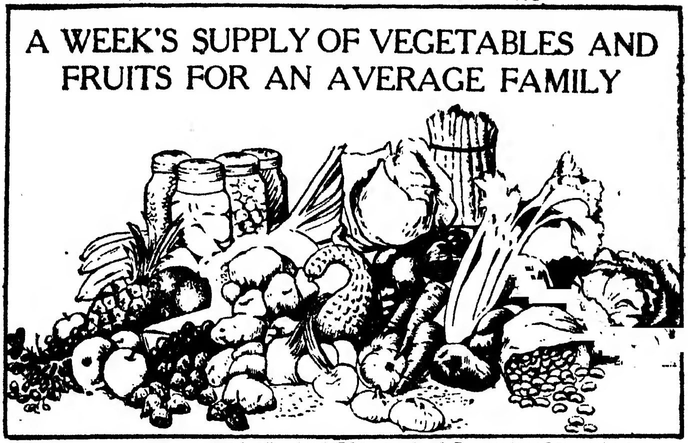
Recipe 19. *Fruit pies*

Fill the pie dish with sliced apples or other fruit, sweeten with sugar, and season with cinnamon or nutmeg. Cover with plain pastry, and bake until the fruit is done and the pastry a light brown.

Cooking and serving of fruits and succulent vegetables. Since fresh fruits and succulent vegetables are our chief sources of minerals and vitamins, both essential for growth and health, it is very important indeed that in the preparation and serving of these foods we should avoid wasting either the minerals or vitamins. The only sure method by which nutrients can be completely conserved is to eat them *raw*. If we eat them raw, we must take every precaution to see that they are *clean*. Unless we grow them ourselves and see that they are fenced in so that dogs and other animals cannot pollute them, we cannot be sure that they are clean. On the other hand, if we must buy them in the market let us patronize the cleanest dealer. After carrying them home, we must *wash* them thoroughly in several waters. The mineral matter and vitamins will soak out into the water, and they should therefore *not be permitted to lie in water*

FOOD SELECTION AND MEAL PLANNING. CHART NO. 2

U.S. DEPARTMENT OF AGRICULTURE. STATES RELATIONS SERVICE.



CONTRIBUTION FROM OFFICE OF HOME ECONOMICS C.F. LANGWORTHY CHIEF.

PREPARED BY CAROLINE L. HUNT. SPECIALIST IN FOOD PREPARATION AND USE

Fig. 164

The total (52 lbs. fresh and canned with 3 lbs. dried, or 70 lbs. fresh weight) provides about 160 hundred calorie portions, or one-fifth the needed fuel. This proportion may be raised or lowered by half. Always use some leaf vegetables.

after they are washed. Wrap them in a piece of clean moistened mulmul, and hang them in a clean, *cool* place, where the air will keep them cool. They will then be ready for use in salads and koshimbeers.

To cook spinach. Some of the leafy vegetables, such as poi (spinach), may be cooked without the addition of any water. Look at the chart giving the composition of these foods, and you will see why. Containing so much water themselves, we have only to put them into the chatti and cover them. Let them cook slowly, and stir occasionally to prevent them sticking to the vessel. It takes a very short time for them to be done. Five or six minutes is sufficient. Another practice to be avoided is that of squeezing out the juice of these vegetables, as is sometimes done with methi.

The juice contains the mineral constituents and vitamins, and should not be thrown away. Now you will be able to tell why we should not soak these vegetables in water, and why we should not throw away the juices of the vegetables. Our reason for cooking these vegetables is chiefly to *sterilize* them, but we also *soften the cellulose*; and we *increase the variety* of our diet by different methods of serving them. We must not f o r g e t that heat will largely destroy the vitamins, especially vitamin C, and, as these vegetables are our chief sources of vitamins A and C, we make a mistake if we over-cook them. Cultivate the taste for *c r i s p* vegetables. We must also realize that bicarbonate of *soda destroys* the vitamins. How, then, should they be cooked? The answer is, cook them *in as little water as possible, for a short time, and without any soda.*

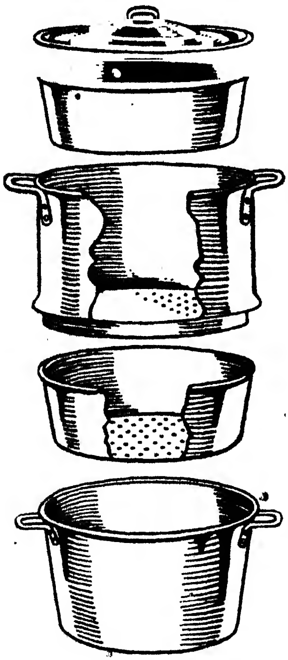


Fig. 165

A steam cooker which will cook several foods at one time

(From *Home Conveniences*, by F. W. Ives, B.S., M.C. Harper & Brothers, New York.)

Some of our fresh vegetables cannot be cooked without the addition of moist heat. *Steaming* is the best method to employ for all such vegetables. There are patent steamers now, easily procurable, like the one shown in Fig. 165, in which several foods can be cooked at the same time. This means great economy of fuel, as only one segri is required to cook a whole dinner. You can see from the diagram, in which a portion of the vessel has been removed, that

the steam from the bottom saucepan can rise through the upper saucepan, and thus cook the foods that are placed above. One other great advantage of this method is that much less water is employed, and the vegetables do not have to stand in it. You should know what food material will be saved in this way. You might improvise a steamer yourselves, by perforating holes in the bottom of a pan and placing it in a slightly larger vessel, into the top of which it will tightly fit, and make a cover.

When your vegetables are cooked in the water itself, your only way of securing the valuable nutrients, which will soak out into the water, is by using this water, which we call *vegetable broth* or stock, in the making of sauces to serve with the vegetables, or thickening it with cooked rice or barley, and taking it as soup. This is very good for everyone, but especially for children.

It is customary to fry our vegetables. When we employ this method, the starch is coated with fat and becomes less easily dissolved by the digestive juices. Our custom is to add masala or phodni to stimulate the digestive organs for their difficult task. This is very hard upon our organs of digestion and is accountable for much of our indigestion and langour after eating.

Recipe 20. *Raw vegetable broth : good for invalids*

Celery	3 stalks	Radish	1
Carrots	3	Potato (white or sweet)	1
Tomato	1	Spinach	1 handful

Cleanse vegetables thoroughly with brush, and rinse with hot water. Grind, preserving the juices. Place in a jar and let the cellulose settle. Pour off liquid and put into a clean bottle. Place in ice-box or a cool place. Serve one tablespoon night and morning to children who fail to eat sufficient green vegetables, to provide minerals and vitamins. *Any five or six vegetables* may be used, avoiding cabbage, cauliflower and turnips, which grow strong in flavour on standing.

Recipe 21. *Vegetable soup*

Carrots	¼ seer ..	Washed and scraped and cut into very small pieces
Turnips	¼ ,, ..	Or pumpkin, or other similar vegetable. Remove the skin and cut it also into pieces
Onion	1 ,, ..	Cut into thin slices
Potato	¾ ,, ..	Pare and cut into small cubes
Any other vegetable you fancy	¼ ,,	
Ghee	2 tolas ..	Melted in a thoa.

Cook all the vegetables, except the potatoes, for 10 minutes, then add the potato and cook 2 minutes more.

Water	4 seers ..	Add the water to the vegetables, and boil until all are soft. Season with salt and pepper, or as desired. Serve hot.

This is excellent for small children, but *not* for infants.

Salads. The art of salad making lies in simplicity of combination and avoidance of much handling. The salad plant should be cleaned when brought to the house, and placed in a damp cloth in a cold place until served. This insures *crispness*, the first essential of a good salad.

All cooked foods used should be prepared in uniform size. All materials should be *cold*, and combined with the dressing at the last possible moment before serving.

Recipe 22. *French dressing*

Vinegar or lime juice	1 tbsp.	Olive oil	3 or 4 tbsp.
Onion juice	¼ tsp.	Pepper	½ tsp.
Salt	1 tsp.		

Put vinegar in a cold cup and add salt, pepper and onion juice. Add olive oil gradually, and stir thoroughly. Onion may be omitted.

Recipe 23. *Vegetable salad*

Use any good combination of cooked vegetables, such as green peas, french beans, beets or carrots, cauliflower, celery, peppers, onions, and tomatoes.

Mix each separately with French dressing, and put in a cold place until time to serve.

Arrange on lettuce, or other salad plant, and serve with any dressing which taste dictates; use, if desired, boiled cream dressing or mayonnaise.

Recipe 24. *Koshimbeer*

Simple koshimbeer may be made of plantains, pine-apple, ripe dates, coco-nut, papaya, tomato, apple and onion.

The method for all is similar, though the amount of sugar and curds may vary with the fruit. Powdered cardamoms may be added, if desired.

Cut the fruit into small pieces, and add about an equal quantity of sugar, and twice the weight of curds. Sprinkle a masa of powdered cardamom over the mixture and serve.

Recipe 25. *Bharit* of brinjal, potato, etc., is prepared by first cooking the vegetable, either boiled or fried, and adding seasonings of green coriander, small pieces of green chilli, powdered red chilli, salt, and curds (sometimes grated coco-nut is added).

Recipe 26. A *phodni* is prepared by putting ghee or oil into a vessel on the fire, and adding asafoetida (hing) and sesame seed. Pour this over the mixture and serve. The phodni corresponds to the French dressing served on salads.

The colour of green vegetables can be intensified by the use of salt in the water employed for cooking. If the vegetable is old and the fibre tough, salt should not be added until the vegetable is done, as it has a tendency to toughen the fibre. The sweet-juiced vegetables should be cooked with as *little water* as possible. Steaming is better than boiling. The juice of these vegetables should be used in making the accompanying sauce or for soup, so as to retain all the mineral matter. In cooking strong-juiced vegetables, use water plentifully and drain before serving.

Recipe 27. *Spinach: good for children and invalids*

Wash spinach thoroughly, but do not soak it. Place in vessel and cover. Cook on moderate fire for 10 or 15 minutes, without adding any water. When tender, chop or force through a sieve.

In preparing either brown or cream sauce to serve with spinach, use the liquor of the vegetable as part of the liquid.

Recipe 28. *Brahmani pullao*

Green peas (tuar pods)	8	tolas ..	Wash and cut into small pieces all these vegetables, and lay aside
French beans (gavar pods)	4	,, ..	
Potatoes	2	,, ..	
Double beans (wal pods)	2	,, ..	
Onions	5	,, ..	Slice very thin
Almonds	2	masa ..	Place in boiling water to 'blanch,' remove skins, and slice lengthwise
Raisins	1½	,, ..	Clean and take out the seeds
Ghee	1	tola ..	Heat in a thoa the onions, almonds and raisins, and fry until brown in the ghee. Put aside on a clean plate
Cloves	5	..	Fry in remaining ghee in a saucepan
Cinnamon	6	bits ..	
Cardamom powder	3	masa ..	
Rice	½	seer ..	Wash and put with
Water	¾	,, ..	Into the chatti. Cover the chatti with a lid and cook the rice. Then add the vegetables, and stir them with the rice over the fire. Cover, and let cook on hot fire for five minutes. Then remove to a slow charcoal fire, to continue cooking slowly. At the time of serving add the sautéd onion, almonds and raisins, and pour two tolas of ghee over the pullao, and serve while hot

Recipe 29. *Curry masala*

Coriander	2 tsp.	Mustard	½ tsp.
Cuscus	1 tsp.	Cloves of garlic	8
Chilli	½ tsp.	Large onion	1
Jeera	½ tsp.	Turmeric	1½ inch

Method. Pound all fine. If you use coco-nut, do not use jeera. Grate fresh coco-nut and use the milk also. If dried coco-nut is used, grind it and use cows' milk.

Recipe 30. *Curry-stuff*

Coco-nut (small)	¼	Rai (mustard seed)	4 masas
Haldi (turmeric) 2″ piece		Chilli	4 ,,
Tuj (bark of cinnamon) 2″ strip		Ginger root	to taste
		Garlic	6
Dhania (coriander seed) 2 tolas or		Pepper corn	2
		Cloves	4
Cuscus (poppy seed) 2 tolas		Cardamom	2
Cumin seed (jeera) 1 level tsp.			

Method. Grind all on curry stones to a fine powder. Fry an onion in ghee or butter, and add the masala or curry mixture to this, and fry. When the curry mixture is brown add water enough, or vegetables, and stew down to a thick sauce. Serve cooked rice, and then the curry to dress it and season it. Chutney is served also as an accompaniment.

Recipe 31. *Acid for curries*

Tamarind pulp is made by first washing the fruit if it is old, and steeping it in cold water enough to cover it for 10 or 15 minutes, then pressing out the pulp. The amount of acid needed for curries is determined by individual taste. The juice of sour limes, dried and green mangoes, and bilambees, are also used as acids in curries, etc.

Recipe 32. *Curry paste*

Dhania or coriander seed, roasted	8 oz.
Jeera or cumin seed, roasted	1 oz.
Haldi or dry turmeric	2 oz.
Chillies	2 oz.
Black pepper, roasted	2 oz.
Mustard seed	2 oz.
Dry ginger	1 oz.
Garlic	1 oz.
Salt	4 oz.

Sugar	4 oz.
Gram dhal without husk and roasted	4 oz.

The above ingredients, in the proportions given, to be carefully pounded and ground down with the best white wine vinegar to the consistency of a thick jelly; then warm some good mustard oil or sweet oil, and, while bubbling, fry in it the mixture until it is reduced to a paste; let it cool, then bottle it.

N.B.—Great care must be taken not to use any water in the preparation, and mustard oil is better than sweet oil for frying the mixture in.

Recipe 33. *Coco-nut oil*

Scrape 3 large old coco-nuts, grind the flakes smoothly with hot water, press out all the milk; strain and simmer on a slow fire till the oil is made.

Recipe 34. *Coco-nut milk*

This is obtained by scraping the white part of a coco-nut into fine flakes, pouring over it half a teacup of warm water, kneading the flakes for a minute or two, and squeezing out all the milk; repeat this twice. This is called the 'thick milk'. Repeat the process twice or thrice again with warm water, and get as much liquid as you need for the curry. This last is styled 'thin milk'.

CHAPTER XV

METHODS OF COOKERY: PROTEIN FOODS, BEVERAGES AND SWEETS

Required.—Proteins, milk, fats, sugar, pulses and beverages.

Cookery of Protein Foods. We must remember always that digestibility means solubility of the material. Our experiment with wheat gluten shows that *protein is hardened by heat*. You are familiar with this fact in heating curds; the casein of the milk, when heated at a high temperature, becomes so hard that it is rendered insoluble.

Fig. 166

The total (milk, 14 qts.; other foods, 10½ lb.) provides about 160 hundred calorie portions, or one-fifth the needed fuel. For adults this proportion may be raised or lowered by half. For three children, the milk should not be lessened.

White of egg will coagulate at 160° F. If eggs are cooked in boiling water they become hard and difficult to digest. The same thing is true of oysters, fish, and the flesh of fowl and animals. If we fry animal protein foods, such as eggs and meat, the temperature of the fat is so high that the proteins are toughened and hardened. This causes us to have indigestion after eating fried foods. If proteins are to be cooked in fat they will need to be protected by some carbohydrate coating.

Proteins of pulses, such as dhal, unlike animal proteins, require cooking to develop them, to soften the cellulose and swell the grains of starch, which are combined with the vegetable protein in the pulses. Since the object of cooking is to make the foods more appetizing and more digestible, we must remember these principles in preparing such foods for the family.

Milk is, as we have seen, one of our most important food materials. It gives us a complete protein. From milk we make many useful foods.

Recipe 35 *To make curds*

Milk 1½ lb. Curd 5 tolas

Boil the quantity to 1 lb. and keep the milk lukewarm. Add 5 tolas of curd, and mix it. Cover it. Keep in a warm place in winter and a cold place in summer.

Curds may also be made by squeezing the juice of half a sour lime into a seer of warm milk, and leaving it for 24 hours.

Recipe 36. *To make butter*

Take a quantity of cream from boiled milk that has been standing for some hours. Let the cream stand for 12 hours. Then put it with a small quantity of water into a churn, and keep it rapidly moving until the butter is formed. Add more water until the butter floats easily, form it into a compact mass with wooden hands.

Or butter may be made in the country fashion, from whole milk that has been standing, by rapidly twisting a ravai until the butter forms in little globules of fat on the sides

of the vessel and in the ravai. This method is slower and makes less butter.

Recipe 37. *To make buttermilk*

Buttermilk is the remains of the milk or cream mixed with water left when the butter is taken out. Or it may be formed by adding water to curds and beating it well. It makes a very wholesome drink.

Recipe 38. *To make mawa*

Mawa is made by evaporating whole fresh milk to about one-third of its original bulk. 1 seer of milk will yield about 15 tolas.

Recipe 39. *To convert butter into ghee*

Simmer the butter on a moderate fire. Strain through coarse muslin in a clean dry jar, and, if wanted to be kept, throw in some pepper-corns. Cork when perfectly cold, and use it in khichdi and sweetmeats.

Recipe 40. *To purify ghee for cooking*

When the ghee has boiled, remove it from the fire and sprinkle on it a little cold water; repeat this if the ghee is at all rancid.

Recipe 41. *Buttermilk curry*

Grind one-third of a small coco-nut, 1 teaspoon of jeera, 1 onion, 1 red chilli, half a garlic, 2 or 3 pepper-corns, a bit of turmeric and a small bunch of kotimer leaf. Warm 3 teacups of butter-milk. Mix in the masala with salt to taste, stirring all the time until it boils, when remove from the fire and let the curry cool. In another vessel warm a heaped teaspoon of ghee. Fry half a garlic sliced, and pour in the curry. Stir and simmer for a few minutes longer.

MILK USED IN SOUPS OR SAUCES. There are two main classes of soups: (1) those prepared with stock and (2) those prepared with milk or cream as a basis.

Foundation sauces. White sauce, or cream sauce, as it is sometimes called, is the most commonly used sauce. It is usually built on a foundation of milk, though not necessarily, for vegetable or fruit juices, or even water, are frequently substituted for the milk.

The consistency varies according to the purpose for which the sauce is to be used. It may be made thin, medium, or thick, simply by varying the proportion of thickening material used. Thin white sauce forms the basis of cream soups.

Recipe 42. *White sauce*

No.	Milk	Flour	Butter	Salt
1	1 seer or 2 cups	1 tbsp. or ½ tola	1 tbsp. or 1 tola	½ tsp. or 2 masas
2	1 ,, ,, 2 ,,	2 ,, ,, 1 ,,	2 ,, ,, 2 tolas	½ ,, ,, 2 ,,
3	1 ,, ,, 2 ,,	3 ,, ,, 1½ tolas	3 ,, ,, 3 ,,	½ ,, ,, 2 ,,
4	1 ,, ,, 2 ,,	4 ,, ,, 2 ,,	4 ,, ,, 4 ,,	½ ,, ,, 2 ,,
5	1 ,, ,, 2 ,,	5 ,, ,, 2½ ,,	5 ,, ,, 5 ,,	½ ,, ,, 2 ,,
6	1 ,, ,, 2 ,,	6 ,, ,, 3 ,,	6 ,, ,, 6 ,,	½ ,, ,, 2 ,,

Nos. 1 or 2 may be used as a foundation for cream soups, with vegetable puree.

Nos. 3 or 4 are used for dressing vegetables.

Nos. 5 or 6 are combined with foods which are to be reheated in the form of croquettes.

There are two methods of combining the ingredients.

1. Melt the butter or ghee in a saucepan, and cook the flour in it. If a brown sauce is desired, allow this to cook until brown. Add the milk, or milk combined with vegetable broth (or water), and stir to prevent lumps. Cook until required thickness. Season with salt.

2. Another method is first to heat most of the milk. Mix the flour with the remainder to a thick paste. Combine and cook, until thick. Add butter or ghee and salt last.

Recipe 43. *Cream soup: good for children and invalids*

White sauces, which are the basis for cream soups, are not usually kept on hand, as the milk is liable to become sour if an attempt is made to keep them. Cream soup, in spite of its name, is usually prepared with milk and a thickening agent, such as flour, cornstarch, or tapioca. When milk is used as the basis, additional fat is needed to give flavour and smoothness to the soup. The fat is blended with the flour to make a paste, into which the hot milk is stirred.

Recipe 44. *Cream of tomato soup*

Tomatoes	2 c.	Ghee	2 tbsp.
Chopped onion	1 tsp.	Salt	½ tsp.
Milk	2 c.	Pepper	¼ tsp.
Flour	4 tbsp.		

Cook the first two ingredients together for 5 or 10 minutes, season them and then strain, and keep hot. Melt ghee, stir in flour until blended, pour in the hot milk. Cook until thickened. Add hot tomato gradually to the white sauce, and serve immediately.

Recipe 45. *Potato soup*

Hot milk	2 c.	Salt	1 tsp.
Raw potatoes	1 c.	Pepper	¼ tsp.
Ghee	2 tbsp.	Minced onion	1 tbsp.

Have potatoes diced in small cubes. Cover with boiling water, add onion, and cook until potatoes are almost tender. Add ghee or butter, and shake potatoes until fat is melted. Add milk and finish cooking. Add salt and pepper and serve immediately.

Recipe 46. *Pulses (dhal), lentil or corn soup.*

Corn or lentils (dhal)	1 c.	Boiling water	1 pt.
Milk	1 pt.	Onion	1 slice
Ghee	2 tbsp.	Flour	2 tbsp.
Pepper	¼ tola		

Combine corn or dhal and water. Simmer 20 minutes. Rub through sieve. Scald milk with onion and add to corn. Melt ghee and blend in flour. Pour hot liquid slowly over the ghee-flour mixture, and cook until thickened. Sprinkle with finely-chopped coriander leaves just before serving.

Recipe 47. *Khichdi*

Clean rice	1 lb.	Mug pulse (dhal)	½ lb.
Salt	2 tolas	Ghee	½ lb.

Mix dhal and rice together. Put the water on the stove in a vessel and let it boil. When boiling, add the mixed rice, pulse and salt. When done, all the water should have been absorbed. While hot, pour the ghee over it and serve.

Recipe 48. *Gram dhal curry*

Boil in a little water half a teacup of gram dhal till the grains are soft. Mash it smooth. Grind a little jeera, a

quarter of a coco-nut, a bit of fresh ginger, a piece of turmeric, two dried chillies and half a garlic. Mix the masala with the dhal. Season with salt, and boil for a few minutes.

Recipe 49. *Varan*

Gram pulse (tur dhal)	14 tolas	Turmeric	¼ tsp.
Asafœtida (hing)	A pinch	Salt	¾ dessertspoon

Method. Clean the pulse (dhal). Put a chatti on the stove with water, and add pulse and cook it. When half cooked, add asafœtida, turmeric, and cover it. After some time the pulse will be well cooked, drain off the water into another pot, and beat the pulse with wooden spoon. Add salt and the strained water, and return to the stove for two minutes.

Recipe 50. *Bhajia (a type of fritter)*

Plantains, potato, onion, brinjal are all suitable for bhajias. These should be prepared in advance by cutting into suitable small pieces. If you are to make them of plantain, then remove the skin and cut them into rings, about ¼ inch thick. Lay aside until required.

Gram flour	⅛ seer
Sesame oil, added for shortening	2 masas
Jeera (cumin seed)	2 masas
Salt	4 masas
Halad or turmeric	½ gunj
Soda or papadkhar	1 gunj
Green chillies, cut into small bits	3
Coriander leaves	A few

Mix all with water to a thick batter (about the proportion of 2 measures of dry ingredients to 1 measure of liquid).

Sesame oil, ⅛ seer; heat in a thoa over the fire.

Dip pieces of plantain into the batter, and fry in hot oil until brown. When done remove from oil, drain, and serve. This is not suitable for small children.

Cookery of Meat and Poultry. Knowledge of the structure of meat is of importance to non-vegetarians when it comes to cooking it. You will remember we learned that muscle tissue is composed of very minute fibres bound together in bundles. They might be likened to tiny tubes

filled with water, in which is held the mineral constituents, extractives, and protein of the meat. In cutting meat, the cut is made across the muscle fibres instead of with them. The meat would be tough unless cut in this way. Can you explain why? In cooking the meat we must decide whether our object is *to draw out* the juices, as in the making of soups and stews, or whether we wish the meat *to retain* the juices, as in grilling and roasting.

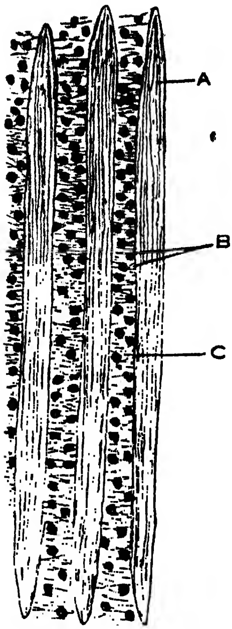


Fig. 167

Diagrammatic representation of the structure of meat. A, muscle fibres; B, fat cells; C, connective tissues.

(From *Food and Dietetics*, by Dr. Robert Hutchison. William Wood & Co., New York.)

You will remember that muscle fibres are held together by connective tissue (Fig. 167). This connective tissue is composed of collegen. When meat is heated, the collegen softens, and changes to a substance known as gelatin, which upon cooling thickens into a jelly. People who like a mixed diet make gelatin the foundation of many attractive dishes. It can be bought in sheets or in granulated form. It is especially nice for the preparation of cold puddings. Children and invalids can often be led to take food, when prepared with gelatin, which they would otherwise refuse. The gelatin is not a complete protein food, as it lacks some of the essential amino acids, but it is usually served in combination with eggs and milk, which make it complete. Vegetarians, who object to taking gelatine because of its animal source, can use Irish moss, which is a seaweed and is sold in a dry state by chemists. When combined with

milk it makes a very attractive pudding, and is an excellent dish for children and invalids.

Experiment 86. *Meat experiments*

1. Mix 2 tablespoonfuls of minced meat with 1 cupful of cold water, in a glass.
2. Mix 2 tablespoonfuls of minced meat with 1 cupful of cold water, and add to it 4 masas of salt.
3. Mix 2 tablepoonfuls of minced meat with 1 cupful of *warm* water, and 4 masas of salt.
4. Mix 2 tablespoonfuls of minced meat with 1 cupful of *boiling water*, and boil it for 1 minute.

Let all of these mixtures stand in glass cups for an hour, and then observe them carefully and compare them as to colour.

Can you explain what the differences are due to?

Does it teach you anything that will be of value in your treatment of meat in cooking it?

If you wish to draw out the juices, what kind of water will you put the meat into?

If you wish to retain the juices, what temperature is necessary to keep the juices in?

If our object is to make *soup or stew*, we place the meat in cool water to *draw out the nutriment* of the meat. The temperature is then gradually raised, but the meat should never be boiled.

If we wish to *grill, roast* or *boil* meat to *retain the juices*, we first apply a high temperature to the surface of the meat, and in this way, by coagulating the protein at the ends of the muscle tubes, we prevent the juices from escaping. As soon as this object has been accomplished, the temperature should be lowered to below the boiling point, and the meat cooked slowly at this moderate temperature until done.

Recipe 51. *Tea*

Tea and water — Sugar and milk

Measure as many cups of water as there are people to be served, and put it on to boil. Use fresh water for making beverages. If the water is stale, the tea will

taste flat. Use a perfectly clean vessel to boil the water in. Water dissolves any material that may be in a vessel, and will consequently taste of the same. Scald the teapot out with hot water before putting in the tea. Unless the pot is hot, the water will be cooled when poured over the tea. Water must be actually *boiling* before being used, or the infusion will be poor. Crush the tea leaves before placing them in the pot. The finer they are the more complete will be the infusion. Use a level teaspoonful of tea leaves for each person to be served, if strong tea is desired. Never let the infusion remain standing on the tea leaves for more than 5 minutes. *Never boil tea.* Such treatment develops tannic acid and is harmful to the stomach. Accompany the tea with a covered pitcher of hot water, to dilute the infusion for those who prefer weak tea. Do not use an old enamelled or tin teapot where the coating is worn off. The tannin of tea combines with the iron thus exposed to form ink. People do not like to drink ink.

There are two methods of making tea. (1) Place the required amount of tea leaves in the scalded teapot, and pour boiling water over them. Cover at once, and let it stand in a warm place for five minutes. Pour off the tea and serve at once. (2) Place the tea leaves in a strainer, or clean piece of mulmul, suspended over a freshly-scalded teapot. Pour the boiling water over the leaves and let it drip through. Serve at once. The enjoyment of tea depends largely upon the neat, clean and dainty service.

Ways of serving tea. Tea may be served hot, with milk or milk and sugar. Some people prefer a slice of sour lime or lemon and sugar. It may be served on crushed ice, with sour lime or lemon.

Recipe 52. *Drip coffee*

Put fresh clean water on the stove to boil. Take a level tablespoonful of powdered coffee for every person, and one more for the coffee-pot. Put it in the dripper, or upper sieve-like part of the pot. A clean piece of mulmul may be hung in the top of the pot to allow the coffee to drip through. As soon as the water begins to boil pour it little by little over the coffee. Let the water drip slowly over the coffee powder. Care should be taken to keep both the water and coffee-pot hot. The coffee-pot must be quite

clean if the coffee is to taste good. The pot can be best washed with hot water and a little soda. A little strong coffee, with an equal or a greater part of milk, is better than much weak coffee and little milk.

Methods of serving coffee. (1) Clear and black, in a *small* cup, for after dinner. (2) With cream, or with cream and sugar. (3) With hot milk, with or without sugar. (4) Over crushed ice, with cream and sugar.

Recipe 53. *Spiced tea*

Tea powder	1 tola	Cardamoms	5
Water	1½ tolas	Cinnamon	¼ tola
Cloves	4	Nutmeg	A pinch

Boil the water and put in tea powder, cloves, cardamoms, cinnamon and nutmeg. When the infusion is of the right colour take down the chatti and add sugar and milk as needed.

Recipe 54. *Spiced coffee*

Water	2 lb.	Cardamoms	5
Coffee powder	1 tola	Milk	½ seer
Saffron	A pinch	Cream	½ lb.
Cloves	4	Sugar	½ lb.
Cinnamon	¼ tola		

Boil well the coffee in water, then add the saffron, cloves, cinnamon, cardamoms, bring to the boil again, then take down and strain it. Mix milk and cream together, and strain into a cloth and put this in the coffee. Add sugar, and boil it again and use it.

Recipe 55. *Cocoa for children and invalids*

Milk	1 seer	Cocoa	1 tola
Boiling water	1 seer	Sugar	1 tola

To make cocoa beverage, scald the milk. Mix the sugar and cocoa with water, and let boil for 5 minutes. Add cooked cocoa and sugar to hot milk, and whisk for 5 minutes. Add extra sugar, if desired, and a spoonful of whipped cream on top. Vanilla or cinnamon may be used to flavour the cocoa for variety.

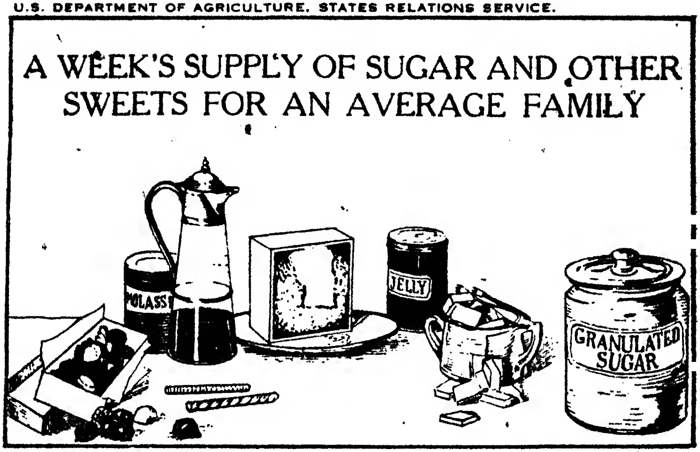
If iced cocoa is desired, allow the beverage to cool, and then pour it over crushed ice, in a tall glass.

Recipe 56. *Lemon squash*

Sugar, water and ice	1 tola
Fresh sour lime or lemon	1 (large)

Add the juice of a sour lime to 1 tola of sugar. Fill up the glass with ice-water, and shake until ingredients are well mixed. Serve very cold. Any other acid or juicy fruit may be also used.

FOOD SELECTION AND MEAL PLANNING. CHART NO. 5
U.S. DEPARTMENT OF AGRICULTURE. STATES RELATIONS SERVICE.



CONTRIBUTION FROM OFFICE OF HOME ECONOMICS C.F. LANGWORTH: CHIEF.
PREPARED BY CAROLINE L. HUNT. SPECIALIST IN FOOD PREPARATION AND USE

FIG. 168

The total (sugar and candy, 3 lb.; honey, syrup, molasses and jelly, each ½ lb.) equals about 4½ lb. of sugar, and provides about 80 hundred calorie portions, or one-tenth the needed fuel. Sweets may be omitted, or their proportion raised by half.

Recipe 57. *Sherbat rang tarha (coloured syrup)*

Peel of oranges	8	Limes	2
Oranges	12	Sugar	2½ lb.

Take the peel of 8 oranges and dry them in the sunlight. Pound and make powder of them. Add the juice of the limes and oranges, and beat with 2 spoons. Strain it with a strainer or through a cloth. Make a thick syrup of the sugar, and add this strained juice to it. Let it cool and put it in a glass jar.

Recipe 58. *Mukhavilas ladoo (sweet balls)*

Mug dhal	½ lb.	Pistachio	1 tola
Ghee	¾ lb.	Cardamom	1 tola

Sugar	1½ lb.	Almonds	5 tolas
Sugar candy	5 tolas	Raisins	5 tolas
Saffron	2 masas		

Soak the dhal in cold water for 5 minutes. Dry it and grind very fine. Fry it in ¾ lb. of ghee. Make a syrup of the sugar. Mix the fried dhal in the syrup. Add a little water to the saffron. This saffron must be added to the syrup. Cut little slices of almonds and pistachios, and add also of the syrup. Grind cardamoms very fine. Mix the cardamoms and raisins and sugar candy in the syrup. Make some balls, the size of a tennis ball. The syrup must be thicker than ordinary syrup.

Recipe 59. *Burani—curd mixture with fruit (eaten with pulao)*

Curd	1 lb.	Sugar	5 tolas
Plantains	3	Ghee	1 tola
Orange	1	Salt	½ tola
Apple	1	Mustard	¼ tola
Sweet lime	1		

Take water from the curd and add slices of the fruits, and add mustard, salt and ghee as phodni.

Recipe 60. *Mango pulp wade (amb-wade)*

Mango pulp boiled thick	1 lb.	Mawa	½ lb.
Sugar	1 lb.	Sugar	¼ lb.

Boil the pulp of mango very thick. The weight of this pulp should be 1 lb. Add the mawa. Make a syrup of 1 lb. of sugar. Pour it over the pulp, and add again ¼ lb. of sugar and roll it with the roller and cut into two-inch pieces.

Recipe 61. *Milk barfi*

Milk	2½ seers	Nutmeg	½ tola
Ghee	¼ seer	Cardamom	1 tola
Charoli	1 tola	Almonds	15
Sugar (granulated)	1 seer	Pistachios	20

Pour the milk into a clean tin vessel, place the vessel on the fire, and let the milk boil until it is reduced from 2½ to 1 seer. Afterwards take it from the fire and strain it through cheese cloth, and take out the remaining water. From the cheese cloth take the mawa and sauté it in ghee. Place another clean tinned pot on the fire, and put in sugar and ½ seer of water, and let it boil. Make

a thick syrup, form a small ball out of it, and drop it in a plate; if this rings when struck, the syrup is ready. Then put the ball of mawa into it, and add powder of cardamom and nutmeg, and turn it frequently; when pearl-like bubbles rise, take it from the fire, and put it in a clean tinned plate of brass, and with your right hand spread it flat and even, and spread over it lengthwise pieces of almonds and pistachios and charoli, and cut it into square pieces with a knife.

FOOD SELECTION AND MEAL PLANNING. CHART NO. 4
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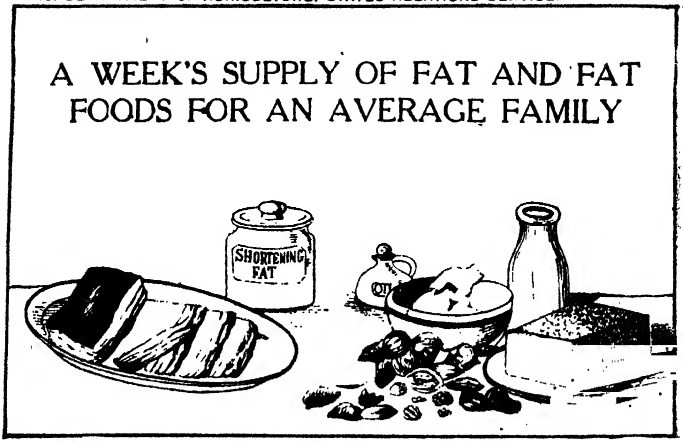

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Fig. 169

The total (butter, 2 lb.; other fats, 1 lb.; bacon, 1 lb.; cream, 1 pt.; nuts, 1 lb.) provides about 160 hundred calorie portions, or one-fifth the needed fuel. This proportion may be raised or lowered by half. The less milk used the more butter needed.

Recipe 62. *Nut brittle*

Sugar 1 lb.	Chopped nuts ½ c.

Heat sugar in a frying pan, stirring constantly until melted. Add nuts. Mix thoroughly and quickly on a tin or iron sheet, and flatten out with a knife or greased rolling pin. Mark into squares before cold. The lighter the colour of the melted sugar, the more delicate the flavour. This candy

must be kept in a dry place, as it readily takes up moisture from the air.

Recipe 63. *Penoche*

Light brown sugar	3 c.	Chopped nuts	$\frac{1}{2}$ c.
Milk (fresh or condensed)	1 c.	Ghee	1 tbsp.

Cook sugar and milk together, stirring slowly until a soft ball is formed in cold water. Add ghee and a pinch of salt. Cool without stirring. Beat until creamy. Add nuts, and pour into greased pan to harden, then cut into squares.

Recipe 64. *Brown sugar fudge*

Brown sugar	$2\frac{1}{2}$ c.	Milk	1 c.
Ghee	2 tbsp.	Chocolate	1 square

Cook sugar, milk and chocolate together until the mixture forms a soft ball in cold water. Stir in ghee and a pinch of salt. Set in a pan of cold water to cool. Beat until creamy. Pour into greased pans to harden. Cut into squares. Chopped nuts may be added if desired.

Recipe 65. *Irish moss blanc-mange.* Good for invalids and children

Irish moss	$\frac{1}{8}$ seer ($\frac{1}{4}$ c.)	Salt	2 gunja ($\frac{1}{16}$ tsp.)
Cold water	$\frac{3}{4}$ seer ($1\frac{1}{2}$ c.)	Vanilla	1 masa ($\frac{1}{8}$ tsp.)
Milk	1 seer ($1\frac{3}{4}$ c.)		

Soak the moss in cold water about fifteen minutes. Remove from water, pick over, and put in a chatti with the milk over hot water. Cook about twenty minutes, or until it thickens when dropped on a cold plate. Add salt, strain and flavour. Strain again, and turn into small cold wet moulds. Chill, and serve with cream and sugar; sliced or stewed fruit.

Recipe 66. *Dudh-pak*

Milk	10 lb.	Cardamoms	$4\frac{1}{2}$ masas
Sugar	$1\frac{1}{2}$ lb.	Almonds	$\frac{1}{4}$ lb.
Rice	$\frac{1}{4}$ lb.	Nutmegs	2
Ghee	1 tola		

Method. Put the fresh milk in a vessel over the stove. Heat it at a high temperature. Begin shaking it with a long, flat spoon. As it reaches its first boiling point put into it rice (already fried in ghee in a separate pan) and then let the mixture of milk and fried rice boil until the rice becomes quite soft. Add sugar to it, and let it boil again

until it becomes pale yellow. Put into it almonds cut lengthwise. Sprinkle over it a powder of cardamoms and nutmeg, and then take it out from the stove. Without almonds, good for children and invalids.

Rules for Freezing Ices in a Freezing Machine

1. Scald the metal container and the cover, as well as the wooden mixer, before putting the cream into it.

2. Fit the container into the wooden bucket, and adjust the crank before packing it with ice and salt.

3. Crush the ice fine and measure it into a basin or chatti.

4. Measure *one* part of coarse rock salt for every *three* parts of crushed ice, and mix them.

5. Pack the ice and salt mixture tightly around the container, but not to the top.

6. Remove the cover, and pour the cream mixture into the container.

7. Readjust the cover and crank securely.

8. Pack ice and salt over the whole top.

9. Turn the crank slowly and steadily.

10. When the cream is frozen, as you can tell by the difficulty with which the churn will turn, remove some of the ice and wipe the cover carefully. Do not let any salt get into the container. Drain out the melted ice water through the hole in the side of the bucket.

11. Take off the cover, and remove the dasher, or churning centre-piece. Pack all the frozen cream down carefully into the container. Cover it again, and put a cork into the hole where the dasher had formerly protruded.

12. Pack the bucket with ice and salt; but use less salt this time. One of salt to four measures of ice is sufficient. Keep the bucket packed and *covered* until time to serve the cream.

AGENDA

Prepare selected dishes illustrating the cooking of the principal foods of your community.

CHAPTER XVI

PRESERVATION OF FOOD

'Make provision for want in time of plenty.

FOOD PRESERVATION. Can you tell me what makes food spoil? If not, refer to Chapter II, which discusses Micro-organisms, Bacteria, Yeasts and Moulds. We said there that we should find some application of that knowledge when we came to consider the preservation of our foods.

We also learned that *some* of these micro-organisms are friendly. Can you name three ways in which they are of benefit to people?

Sometimes these micro-organisms are our enemies, for they eat our food and cause it to decay and ferment. *How can we prevent this?*

There are three chief methods of preventing food from spoiling:

1. By means of a *high temperature.*
2. With such *harmless preservatives* as sugar, salt, acids, spice.
3. By removing the water they contain, *through drying.*

We have discussed the necessity of keeping our corn, pulses and food seeds *dry*, if we do not wish them to spoil. We are familiar also with the fact that fruits and vegetables will keep when they are dried, for we buy dried dates, apricots, and dhal, wheat, rice, etc. We also know that when the milk is evaporated by *boiling*, in making mawa, it will keep much longer, and that pedha, which has *sugar* in it, is not attacked by the ferments. *Spices*, too, are not agreeable to the micro-organisms, and when we use them

in making chutneys, and combine them with *acid* in making pickles, mangoes and other fruits will keep quite well.

In the European stores you have seen foods preserved in tins and bottles. Would you like to know how this is done? The advantage of the method is that the fresh fruits and vegetables, which we have only at one season, may be kept in almost their natural condition for use all the year around.

If we wish to have tomato juice for the baby, or to season our foods with tomatoes, we can bottle them.

In the first place we must realize that the secret of success in keeping food from spoiling and in bottling foods is *cleanliness.*

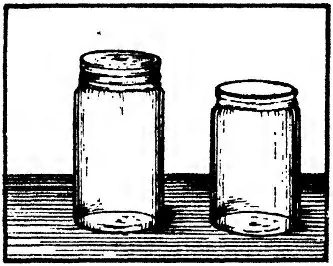

Fig. 170
Wide-mouthed jars

We must first *select the bottles*, or jars, in which the food is to be stored, with great care. Special bottles, with close-fitting covers or screw tops, are required (Fig. 170). It will be necessary to test the covers, to see that when they are adjusted there is no leakage. To ensure this we use *rubber rings*, which fit around the neck of the jars. They must be new and good. Place one of these on the bottle, put some water in it, screw down the cover as tight as you can. Invert the bottle and see if it is perfectly tight and no water can leak out. If this is not the case, it is useless to try to keep the food in it from spoiling. Therefore, you must look for the trouble and remedy it.

When your bottles are selected, they must be carefully *washed* and *boiled* to sterilize them. This is done by putting something like a plaintain leaf or grass on the bottom of a

large chatti, to keep the bottles from touching the bottom of the vessel. Place the bottles on this, and put cold water inside and outside the bottles, to cover them, and set the chatti over the fire. Or the bottles may be set in a rack which fits in the saucepan (Fig. 171). Let the water come to the boil and *boil the bottles* for ten minutes. Put the covers and rubber rings in another small vessel of water and *boil them.*

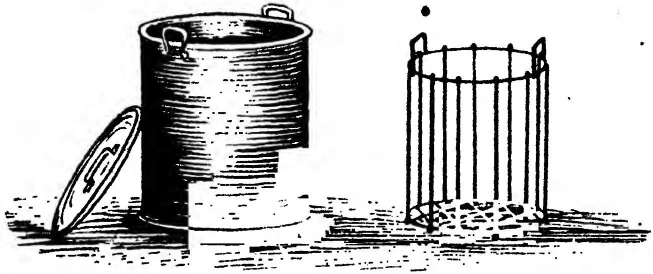

Fig. 171

Water bath for sterilizing bottles and rack for holding them (Barker)

Acid fruits and vegetables are most easily kept, for when they are heated the hot acids in them readily destroy the micro-organisms. Tomatoes are, therefore, especially adapted for bottling.

Preparing the fruit for bottling is the next thing to be done. Large fruits like pears, mangoes, guavas, etc. must have their skins removed. Tomatoes can be dipped into boiling water and then into cold water, and the skin will come off at once. Some fruits must be stoned, others cut in halves.

There are *two methods* you may now follow, to sterilize and cook the fruits or vegetables. These two methods are called (1) the open vessel method, and (2) the cold pack method.

The *open method* is that which is most commonly used,

and it is accomplished by first cooking the fruit in the chatti, before putting it into the bottles. The *advantage* of this method is that you can reduce the amount of liquid in the fruit or vegetable by boiling it, and it will not require so many bottles to hold it. The *disadvantage* of the method is that, if anything concerned with the process is not absolutely sterile, the fruit will get some bacteria into it, which will cause it to ferment and spoil.

The *cold pack method* gets its name from the fact that the fruit is packed into the bottles while it is cold, and then the bottle is filled with syrup (if it is a fruit you are bottling) or with water and a little salt (if it is a vegetable). In this method, after the bottles are filled, you adjust the rings and lids and screw them down, but *not quite* tight. Then put them back into the chatti and cover with water and boil the bottle with fruit in it until it is done. This takes less time when the fruit is small than when it is large. Berries only need to be sterilized for fifteen minutes; tomatoes require half an hour. The water around the bottle must *boil* briskly the whole time. Pears and guavas will need to boil for half an hour, and mangoes the same. When done, take the jars out of the water and screw the cover *tight*.

To prevent breaking the jars, be sure that the temperatures of the mixture inside the jar and of the water outside it, are the same.

Recipe 67. *Bottled mangoes*

Sound mangoes, uniform in size, should be used for bottling, and the soft, broken ones should be used for marmalade and conserve. If possible, they should be bottled on the same day on which they are picked.

Make a syrup first, using from ½ to ¾ cup of sugar to each cup of water, and boil it for from 3 to 5 minutes. Allow about 1 cup of syrup for each quart jar of fruit.

(1) *Cold pack method.* Peel and remove the stone or seed. Pack the fruit in halves, in overlapping layers, with the

rounded side uppermost and the blossom end facing the glass, or use sliced mangoes. Fill each jar with hot syrup, and adjust the rubber, the cover, and screw tightly; then give one half-turn backwards, thus partly unsealing the jar. Place the jars on a rack in a hot water bath that covers the tops to depth of one inch. Bring the water to the boiling point and boil the jars for 20 minutes. Remove the jars, seal them, and invert them to cool.

(2) *Open pan method.* Cook the mangoes in the syrup until they are tender; then, with a clean spoon, slip them carefully into a jar that has been thoroughly cleaned and boiled for 20 minutes, and fill the jar to overflowing with syrup.

Or the mangoes may be cooked to a pulp, and bottled. Adjust the rubber which has been in boiling water for 5 minutes, and the cover, which has been boiled with the jar. Seal the jars immediately and invert them to cool.

Recipe 68. *Bottled pears, guavas or apricots*

Pears for bottling should be ripe, but firm, and of uniform size. Pears are either bottled whole or cut in halves. Peel them and, if they are to be cut, divide them evenly into halves and remove the cores. When bottling them whole, remove the blossom end, but leave the stem. Place each layer in the jar with the stem up, allowing those in the second layer to fill the space between those in the first. Pears darken on standing after the skin is removed, and therefore, should be covered with cold water until they are ready for bottling.

The directions given for mangoes, either by the cold pack or the open pan method, may be used for bottling pears.

Recipe 69. *Marmalade*

Oranges	7 lb.	Lemons	2
Water	10 pts. (seers)	Sugar	10 lb. (seers)

Mince oranges and lemons; add water; boil rapidly for 1 hour; add sugar; and boil for 1 hour. Seal in sterilized jars.

Recipe 70. *Amb-ras (mango pulp)*

First take the pulp from the mangoes and put it on the stove. Cook until very thick. To 1 lb. of pulp add 2 lb. of sugar. Again put the pulp on the stove and boil it. Add

1 tola of cardamoms and strain the mixture. Pour it into a bottle, and close it with a new cork. This will keep for a year. If you want to use the pulp, add milk.

Directions for bottling vegetables by the cold pack method. The same directions may be applied to the bottling of vegetables. If it is necessary to steam the vegetables, this should be continued just long enough to make the vegetables sufficiently flexible to pack easily, or to loosen the skins sufficiently to allow them to be quickly scraped off. Spinach and other delicately flavoured greens should be steamed until they are thoroughly shrunken.

Shake the jars to get a good pack, but do not press down the vegetables with a spoon.

Add from one half to one teaspoonful of salt to each pint jar. Some vegetables, such as peas, beans and pumpkin, are improved by the addition of a small amount of sugar as well.

Use of acid. As we said before, bacteria cannot grow well in the presence of acid. Some vegetables are difficult to bottle successfully on account of their natural lack of acid, and thus a small amount of tamarind vinegar or lime juice is used. The acid seems to increase the chances of success in the bottling of peas, beans, asparagus and other greens. The acid flavour with most of these vegetables is scarcely noticeable, and to most persons not objectionable.

For each pint jar of vegetables one teaspoonful of salt and one tablespoonful of vinegar or lemon juice are used, and the jars are boiled in the hot water bath for one to one and a half hours.

Bottled tomatoes. Select tomatoes that are ripe, but not over-ripe, free from blemishes, and of medium size, if possible. They should be red to the stem end, since green parts produce poor flavour and colour. Imperfect tomatoes may be used for ketchup or soup puree, or made into juice for filling the spaces left in a jar after it is packed with whole tomatoes.

Scald a few tomatoes at a time in boiling water for from half a minute to two minutes, according to ripeness, using a wire basket or a thin cloth. Dip them into cold water and remove them quickly. With a small sharp paring knife cut out the stem core, then, with a quick turn of the wrist, twist the skins from the tomatoes without removing the pulp. If the pulp adheres to the skin, the tomatoes have been scalded either too long or not long enough. As they are peeled lay them in shallow pans.

If the *cold pack method* is used, pack the scalded tomatoes into the jars, pressing them down firmly with a wooden spoon. Fill the jars to within one-fourth inch of the top with boiling tomato juice. Add one teaspoonful of salt for each quart, and from one teaspoonful to one tablespoonful of sugar, if desired. Boil the jars in the hot water bath for 30 minutes. Be cautious about attempting to bottle too many tomatoes at a time by the cold pack method.

If the *open pan method* is used, thoroughly clean the jars and the covers by boiling them for 20 minutes. Add salt and sugar to the tomatoes in the proportions recommended for the cold pack method. Add no water, because the tomatoes will make their own juice as they become heated. Bring them to the boiling point, and boil them for 10 minutes. Empty the hot water from the jars, adjust the rubbers and, with clean spoons, ladle the boiling tomatoes into the jars, filling them to overflowing with the boiling juice. Adjust the clean tops immediately and seal the jars. Invert the jars to cool, avoiding a draught on them.

Recipe 71. *Tomato puree*

Tomatoes	4 lb.	Bay leaf	1
Onion (sliced)	1 small	Salt	2 tsp.
Celery	1 stalk	Pepper corns	6

Cook the mixture until the tomatoes are tender, and put it through the strainer. Boil the pulp until it is reduced to one-half the original volume. Seal it in hot, clean jars. This is valuable for soups and sauces.

The tomato pulp may be bottled in the same fashion, without the seasonings, if preferred.

Recipe 72. *Lime pickle*

Pound fine a quarter tola of the best hing. *Grind* to powder, separately, 1½ oz. turmeric, 3 wine glasses of methi seed; and 3 oz. husked mustard seed. Boil a teacup of mustard or sweet oil. Take the chatti from the fire, stir and mix well in the oil first the hing powder; then the mustard, methi and turmeric flour. When the mixture is cold, stir in 12 oz. of pounded salt. Cut the limes in quarters, put in each some of the mixture, and pack them in a jar. The oil must float on top. Stopper the jar well, and seal with paraffin wax.

Recipe 73. *To preserve ginger*

Young pink roots of ginger	20 seers	Sugar	20 seers
Borax	2½ tolas	Limes	2 seers of juice

Wash the ginger roots thoroughly. Scrape. Prick them with a fork. Wash again. Put on the fire with plenty of cold water. Let it boil for 2 or 3 hours. Pour fresh water over ginger roots, sufficient to cover them completely. Add 2½ tolas borax to every 20 lb. ginger. The borax from the bazaar is in lumps, and must be heated in a pan to make it light and puffy. Boil for 1 hour in borax water. Drain off and throw away the water. Add fresh water, and boil ginger until tender, but not too soft. Drain off water again. To every 1 lb. ginger add 1 lb. sugar and 3 tablespoonfuls of lime juice. Add a little water to moisten the sugar, and cook until sugar is thick syrup (but not enough to spin a thread). If you wish to crystallize the ginger, cook it until it sugars, otherwise put the preserved ginger in jars. The water poured off the fresh ginger after first cooking may be used to make ginger syrup, useful for flavouring puddings and ices. Drain off this water, and use it for making ginger syrup as follows:

Citric acid	1 oz.
Sugar	3 lb.
Hot ginger	4 c.

Drying. Dry products do not require expensive containers, and they can be stored almost indefinitely under proper

conditions in relatively small space. Vegetables and fruits, if properly dried, retain much of their natural flavour and food value; in some cases they are more palatable than when bottled, in others they are less palatable. If an ample supply of containers is available, however, it may be better to bottle most surplus fruits and vegetables, since drying in many cases requires more time and labour.

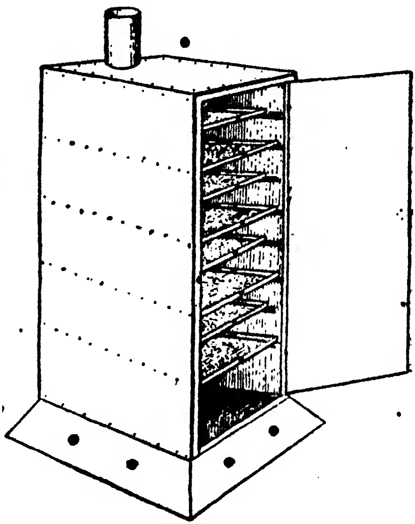

Fig. 172
Home-made drier, to stand on top of the range

Apples, pears, peaches and cherries seem to be the foods most commonly dried by housekeepers.

Proper ventilation that allows for a free circulation of dry air is more important than heat in drying foods. For example, an electric fan, placed before a drier, may accomplish excellent results without the aid of heat. However, the use of heat is more practicable in most homes.

The temperature for drying should be rather low to prevent scorching, but the more quickly the food is dried, the better will be the colour and the flavour.

If food is to be dried over a kitchen stove or outdoors, it should be carefully protected from dust and from flies. Coarse cheese cloth may be laid over the food in the house. If the food is outdoors, the covering of cheese cloth should be raised by means of supports or

racks, so that it will not rest directly on the food and thus allow possible contamination from flies. Especially in the case of food that is entirely or partly dried outdoors, and that is to be used without being cooked, every precaution should be taken to prevent the spreading of certain intestinal diseases that may be carried by flies.

Equipment for drying. A very slow oven may be used for drying fruits and vegetables spread on papers, large plates, sheets of metal, or pieces of heavy netting, with an inch or two turned down at opposite ends for supports. The heat must be carefully controlled to prevent scorching. The oven door should be left slightly open to allow a circulation of air to carry off the moisture set free by evaporation. Or a drier (Fig. 172) may stand on the stove.

In the preparation of dried fruits for table, prolonged soaking, even to the extent of 48 hours, is advisable before cooking. This ensures the complete return of water to the tissues. The water was evaporated slowly in the drying, and thus a better flavour is produced if that water is slowly returned. Cooking for any length of time is then rendered unnecessary—bringing to the boil for purposes of sterilization is all that is required.

AGENDA

Oral and Practical Work

1. Why do foods spoil?
2. In what three ways can this be prevented?
3. What is the real secret of success in preserving food?
4. What two methods are there for bottling fruits and vegetables?

CHAPTER XVII

HOME MANAGEMENT

'A little thing is a little thing; but faithfulness in little things is a very great thing.'

Required.—Paper, ruler, brass, ammonia, whiting, aritha, woodash, soap, tarnished metal utensils, cloths, chamois leather, account books.

THE KITCHEN AND ITS CARE. In India the art of cookery has been looked upon as a sacred rite, and many precise rules control the arrangement and management of the work. The mother, in her silken sari, is the priestess who presides over the affairs of the kitchen, and the ancient laws have provided that perfect cleanliness of person shall prevail. What orthodox Hindu would enter the kitchen without first having bathed and changed her garments to those of silk? Similarly, no one would enter this room with shoes on her feet. The dirt of the streets is in this way excluded. Now these laws were made for a purpose, for in a hot climate *food is easily spoiled* and, as we have learned, the dust is laden with germ life and the spores of moulds.

Other peoples have other customs regarding the best costume in which to work. It is their habit to wear a dress or apron of white cotton, of so simple a pattern that it can be washed easily. In this way they not only protect their own clothes, but keep the food clean. A cover for the hair is an important part of the kitchen outfit. Then we should provide ourselves with pot-holders which can be swung by a tape to our waist-band and be ever ready when needed. It is a good precaution to have a small towel pinned there also, for use in wiping the hands. This obviates the temptation to wipe one's hands on the apron or dish cloths.

The kitchen. There are two chief processes to be performed in the kitchen: (1) the cleaning, preparing, cooking and serving of food and (2) the removing, washing and putting-away of utensils. It is important that we plan our kitchen arrangements that these two processes may be performed with as little unnecessary work as possible. In any case the work is long and tedious, and our time and strength should not be wasted when we need it for other things. Our shoulders grow round with sitting on the floor and grinding, pounding, rolling and cooking. No wonder we look old before our husbands do. Let us see if we cannot prevent our backs from aching, and keep our good looks also.

To perform the *first* set of processes in the *preparation of the food*, let us arrange the equipment in the right sequence to save labour. Where will we find the materials needed for the cooking? The stores, cupboard and safe should be on the cool side of the room, and easily accessible. What will be next required? Probably water for washing, and vessels for cooking the food in. Therefore, we will arrange these things close together. The place for grinding must be near by also. Next in line should be the chula, or segri, for cooking, and our fuel must also be within easy reach. The utensils, such as thoa, frying-pans, and oven should be arranged conveniently near. For serving, the table will be required again. And this should come in close proximity to the place of eating the food.

For the *second* process, that of *clearing away the meal*, the dishes to be washed must be carried to the sink, after being scraped as clean as possible, and then washed. The place for storing the dishes and utensils used in eating should be convenient to sink and place of eating also.

We should arrange our kitchens, store-room and equipment in the most efficient way (Figs. 173 and 174).

Very often, though, the kitchen is a small and dark room, which is both inconvenient and difficult to keep clean. We should select for the place in which the food of the family is to be prepared a light dry room with good ventilation. Two windows are necessary for this, especially when there is no chimney to carry away the smoke and fumes of cooking.

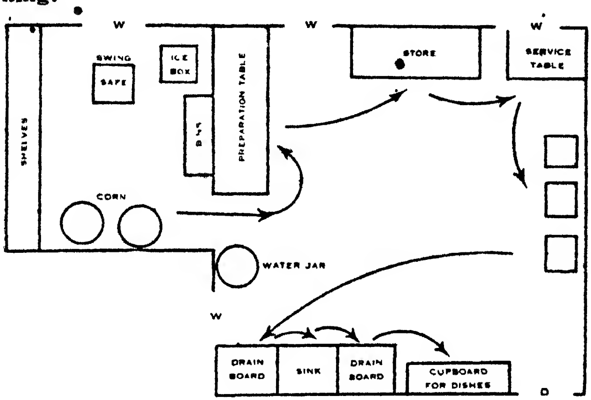

Fig. 173

W = window ; D = door into dining-room. Store-room and kitchen arranged with equipment in correct sequence

Exercise 16. Draw a plan of your kitchen, store-room and place of eating at home, and see if it conforms to these conditions. Here is a plan of a kitchen in which the family also takes its food. If there was a special dining-room it should be through the door near the place allowed for eating.

Do you notice that everything required for preparing the food is arranged in sequence from *left to right*? This is the most convenient way to work, and saves steps. Also notice that the dishes, after being washed, are moved from *right to left*, where they are stored. Cleaning up processes are most easily performed in this way. Try it and see.

Working heights. The best height for each of us must be determined for ourselves, but commonly you will find a table of from 27 inches to 30 inches about right for your height. If you are over five feet tall, the working surfaces

must be correspondingly raised. Low tables can be raised on blocks of wood or brick.

The sink has to be somewhat higher, since we work on the bottom and not on the top rim of the sink. The same thing is true of washtubs. But a table for ironing needs to be lower, since we have to put some pressure on the iron to make our clothing smooth. If we sit on the floor to work, or work at tables which are too low, we bend our backs and injure our health. The places for bending, designed by nature, are the hips and knees.

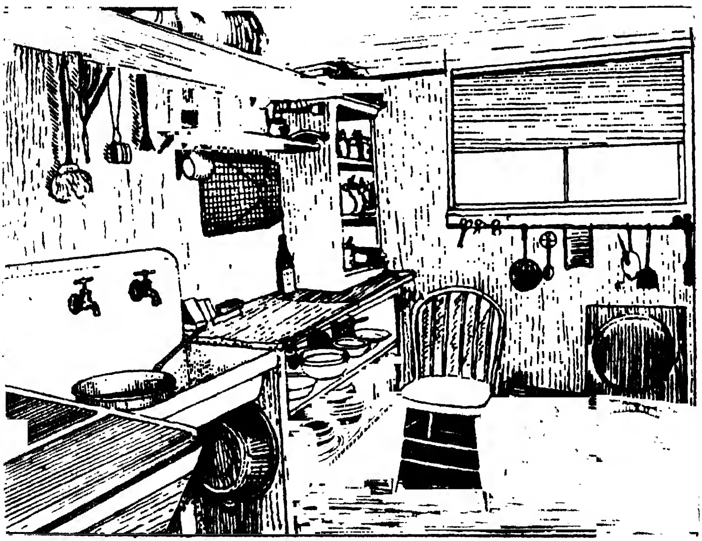

Fig. 174

Convenient arrangement of equipment to save time and energy

(From *New Housekeeping*, by Christine Frederick. Doubleday, Page & Co., New York, 1913.)

It is far more efficient to have the stove raised to the level of your elbow when standing. A wide brick platform will thus provide a convenient place for setting the chatties and

saucepans, and is much cleaner than the floor. On this the mud-stoves, chula, or charcoal segri can stand.

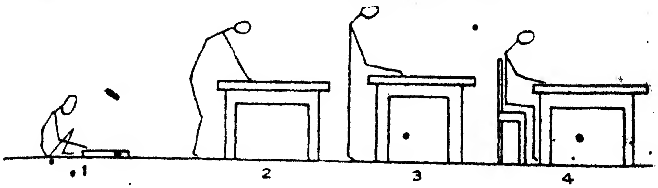

Fig. 175

Which one will work longer, and more efficiently? Which one will have a backache and feel general fatigue?

Water should be brought into the kitchen in pipes, if possible, and a sink with sanitary drain is best. Sinks that are raised to the elbow height are far easier to work at than the low drain in the floor.

A work-table of the height which does not necessitate stooping will be found far more comfortable than the pat on the floor (Fig. 175).

Equipment: Stoves. For economy of wood the *chula* is indeed very efficient, as small sticks can be burned in it and only a few are required at a time. When dung is burned for fuel, we must realize that the nitrogen of this material is being wasted, and it would be of much greater value if used on the gardens or fields to produce food.

The *charcoal segri* has the advantage of producing no smoke. On the other hand, the fumes of unconsumed carbon monoxide are dangerous unless the room is well ventilated. The scarcity of fuel is doubtless responsible for our not having stoves with ovens. This has resulted in our frying food a great deal more than would otherwise be necessary. A metal pan, with deep sides and a close-fitting cover, may be used like an oven for baking. Hot ashes are used to line the bottom of the pan, on which the material to be cooked is placed in another tin. Hot ashes are also placed on top of the cover.

There are very good *kerosene stoves* on the market, with small ovens, which are efficient. They are known as blue-flame stoves and, in a hot climate, have the advantage of not heating the room (Fig. 176). For those who can afford them they are an excellent investment. They must be kept clean and in good order, or the odour of the kerosene oil will become objectionable.

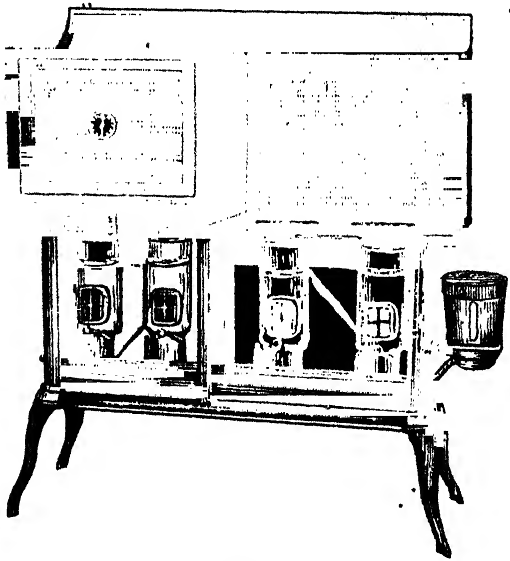

Fig. 176
Blue flame kerosene stove, good for hot climate

For the greatest economy of fuel, a *fireless cooker* is certainly the best (Fig. 177). One must have a segri to heat the food first, before it is put into the fireless cooker, but for foods requiring long boiling they are splendid. The plan for making one is given (Fig. 178). The hole in which the pot is to be put is surrounded by non-conducting or insulating material, such as hay or straw, so that the pot and

its contents, when once brought to boiling point, remain at a high temperature and continue to cook slowly. More than twice the time is required, but fuel and labour are saved.

Steam cookers are now obtainable which make it possible to cook several articles at one time on the segri. These are very efficient, and every housewife should own one. The steaming of food is the best way of cooking it also.

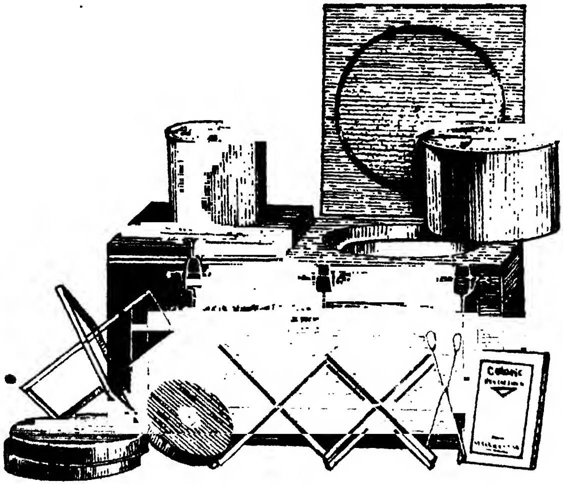

Fig. 177

A fireless cooker, and how to make one

(From *Housewifery*, by L. R. Balderston. J. B. Lippincott,

Kitchen utensils. It is best to have several sizes of *chatties* or *saucepans*, one fitting inside the other like a nest, and ranging in size from one foot or more in diameter, and one foot deep, to the smallest which you may require. These must be supplied with close-fitting covers. Copper and brass do very well for this, but they require tinning frequently. Have you ever thought what becomes of the tin? Aluminium saucepans are much lighter and more serviceable

more easily cleaned, and do not require tinning. We require one or two *frying-pans*, and these are best made of iron, like the *thoa*. The latter has a curved bottom, while the bottom of frying pans are usually flat. The thicker the metal, the better for these utensils. It makes roasting more even and is not so apt to burn the food. We require two or three larger *earthenware jars* for clean water. It is wise to have three, so that one can always be washed and sunned while the others are in use. Petrol tins, fitted with covers, are suitable for waste water. The large *spoons*, or dippers, made of half a coco-nut shell, are convenient and cheap. We shall require a smooth, hard, *black stone*, 1 foot by 1½ feet in size, and a round stone roller. These require to be roughened from time to time by the stone-mason. The iron or brass mortar and pestle are suitable for pounding spices and coffee. A smooth *board*, for rolling bread and pastry, should not be too small for convenience, and a pin, or *belen*, will be

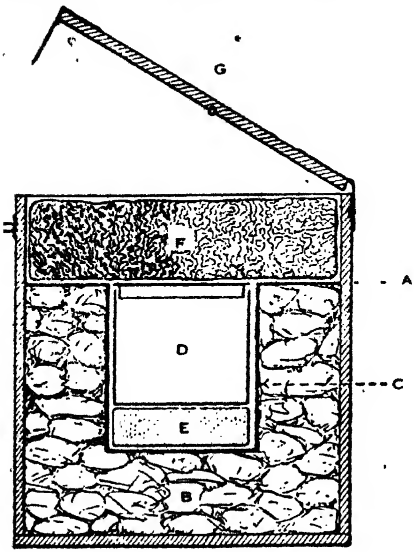

Fig. 178

Home-made fireless cooker. A, outside container-box or trunk; B, insulating material—paper, sawdust, cinders; C, metal lining of nest—tin, zinc, aluminium; D, cooking kettle—aluminium, agate; E, soapstone plate, or some heat-containing material; F, pad of excelsior for covering; G, hinged cover for the top of the outside

needed (Fig. 179). A round bottle can be used for a belen, and is smooth and clean for the purpose. Another small board is needed for mincing herbs, etc., and in the kitchen where meat is cooked a *meat block*, cut from a cross grain of hard wood, for cutting the meat, and a large knife or *koitha*, are necessary. We need a *scraper* for the coco-nut: a circular piece of metal, edged with teeth and fixed to a

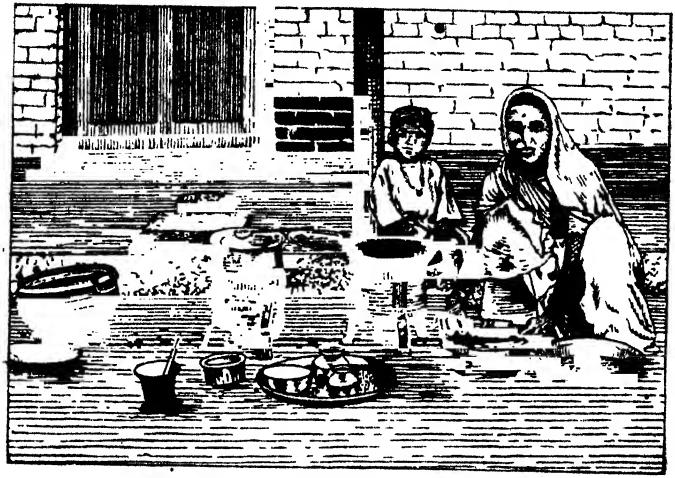

Fig. 179
Kitchen utensils commonly required

piece of wood, is the kind generally used. As far as possible, all these implements should be arranged in a place in which they can be hung up. *Weights and scales* are also necessary in the kitchen for many reasons. Measuring cups and spoons are useful, if obtainable, and will save much time weighing. Besides these tools, we need *cups and plates*, for holding liquids and spices, while we are cooking. These are the chief tools required, but may be added to as one's purse permits.

In each instance it is most efficient to hang or place your

tools as close as possible to the place where they are to be used. Articles useful for washing up should be near the sink. Tools needed for preparation may be hung above, or put in a drawer of the preparation table. Frying pans, thoa, etc., should be kept near the stove. In this way we can always find ready to hand a tool when it is required.

Storage of food. How shall we store and keep our foods?

Since it is much more economical to buy our dry foods in large quantities, it becomes a real problem to store them where they will keep dry and where the vermin cannot attack them. Our store-room should also be in a convenient place for us to get the foods when needed. It is, therefore, on both accounts *unwise* to store the cereal grains in dark, damp rooms on the ground floor. We must remember also, that if we attract rats to our home by storing corn in an easily accessible place, we will be running the danger of bringing plague into the home. Large, circular metal bins for grains are the best. If earthen jars are used, they must have no cracks, and should be provided with well-fitted covers. If it is an earth floor, it would be wise to lift the jars on to wooden racks that will allow the air to circulate under and keep them dry.

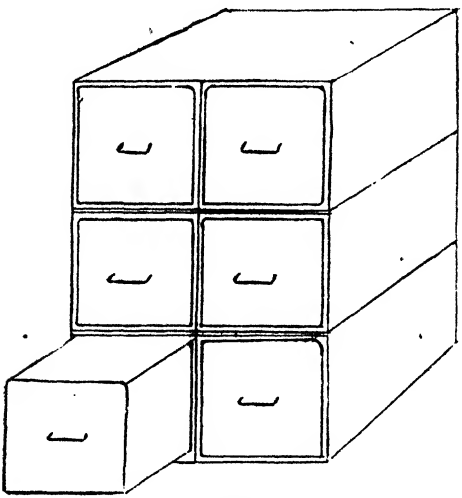

Fig. 180

Storage bins made from petrol boxes and tins

In the food store-room no other stores should be kept. It should have a window which is easily opened to give air as well as light. In this room, as in the kitchen, everything should have an easily cleaned surface. Stone, tile or concrete are best, but are expensive. There should be shelves, placed at a convenient height, neither too wide nor too narrow for the containers in which the materials are to be stored. Do not waste space by having the shelves too far

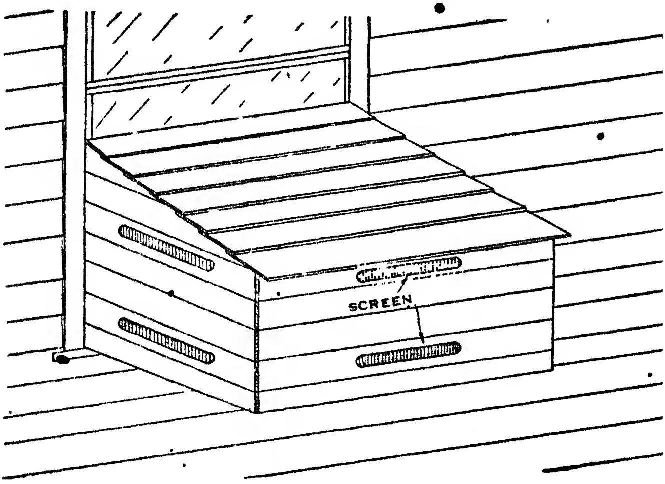

Fig. 181
Exterior view, window-box refrigerator
(From *Home Conveniences*, by F. W. Ives. Harper & Bros.)

apart. If you are having shelves made, it is wise to decide what is to go on each shelf, and measure the jars or tins; then have shelves arranged to fit them. Boxes for pulses, etc., should be tin-lined. A series of boxes, made to the right size, lined with petrol tins, would make good and sanitary containers. They might be arranged like a chest of drawers (Fig. 180). A good tin cover would be required to make all vermin-proof.

Label your containers so that you will know what each contains before you open it. A little paint makes them look neat, and the names can be painted on in another colour.

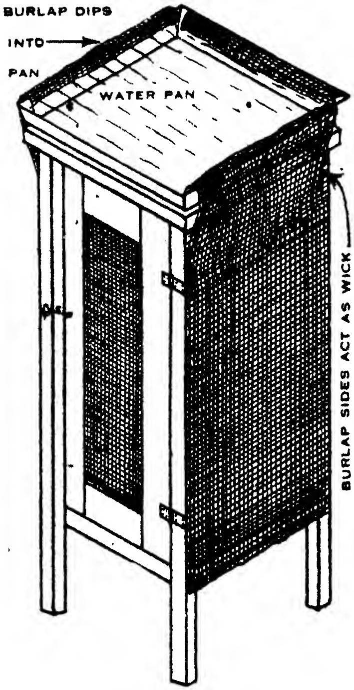

Fig. 182

Simple iceless refrigerator, and method of making it

(From *Home Conveniences*, by F. W. Ives. Harper & Bros.)

How shall we keep our fruit and fresh vegetables? The best plan is to have a wire cage which can be swung from the ceiling. In this way the air can reach them, but the rats cannot.

Will you keep the milk and ghee with the other foods? A window-box makes a good place (Fig. 181), if hung on the cool side of the house.

We must provide a special place for keeping the milk. It must be both cool and clean. The lota or jug in which milk is kept should not be used for any other purpose. Like the drinking water, it will keep cooler in a draught of air.

You can make a good *fly-proof* safe with some mulmul if you cannot afford the wire-gauze. Make a frame of any convenient size or shape, with shelves to hold the food. It should rest on legs or a pedestal, in a tray or other vessel to receive the drip. Stand a pan of water on top of the safe (Figs. 182 and 183). Take pieces of chaddar, and let them lie in the pan of water on top and dip over the sides.

The evaporation of moisture will reduce the temperature under the cloth to as low as 50° Fahrenheit.

It is of great importance that insects be prevented from contaminating the food.

Principles of cleaning the kitchen and equipment. If you refer back to Chapter II, you will understand why *sunshine* is the most important factor in the cleanliness of the household. We are blessed with an abundance of warm sunshine, and because of the heat we are inclined to exclude this beneficent gift of the divine from our homes. Naturally, we must close up the house during the middle of the day, but the morning light should be allowed to penetrate every part of our rooms. Sunlight will destroy bacteria, yeasts and moulds, and prevent rust, tarnish and mildew.

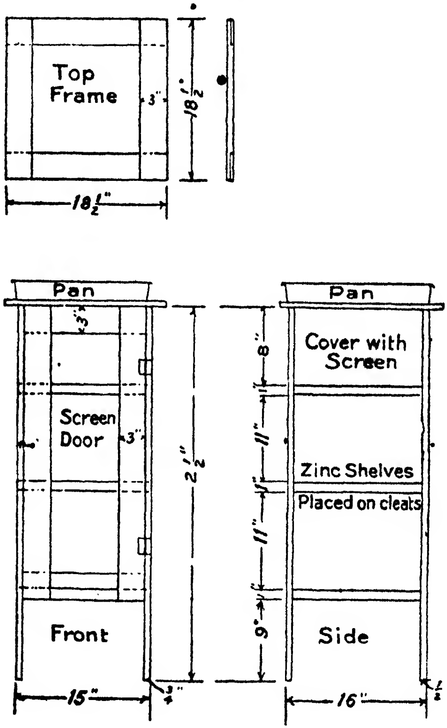

Fig. 183

The second important factor is *clean fresh air*. To flood

our rooms at least twice daily with a strong draught of air is wise, and our kitchen should be well ventilated to keep away the fumes of the fuel and food. For efficient work we need to be able to see what we are doing and therefore light should be placed so that it will fall upon our place for preparing food and our stove for cooking. If the kitchen is not well ventilated, we shall feel fatigued by our work much more quickly.

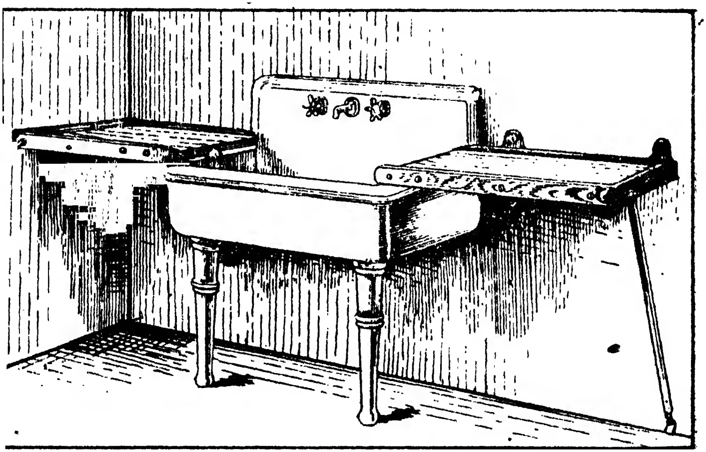

Fig. 184

Sinks should have two drain boards for efficiency.
(From *Housewifery*, by L. R. Balderston. J. B. Lippincott.)

Water is the great solvent by which we clean our utensils for cooking. If this is brought in pipes to our kitchen we are indeed fortunate. Whether this is so or not, water must be stored for use, and the Hindu law governing its care should be carried out in practice as well as letter. If we have a sink (Fig. 184), waste water can be carried away in the drain, and this drain must be kept very clean. If any greasy water is poured down the drain, it should be followed by

boiling water to prevent the grease from collecting and sticking on the sides. The sink should be carefully scrubbed and wiped after clearing up from a meal and, if any part is of iron, it should be wiped dry to prevent rust. If rusty, use kerosene oil upon it, and sprinkle some chuna, or lime, and leave overnight. Polish your brass taps with rotten-stone and oil, and rub with a dry cloth. If very greasy, wash with water in which a little washing-soda has been dissolved. Nickel taps should merely be washed and wiped.

Garbage tin or basket. Solid waste material should be collected in a petrol tin, to which has been fitted a wire handle and close-fitting cover. It is wise to have two, if possible, so that one can be washed and sunned on alternate days. Rinse with washing-soda dissolved in boiling water, and dry in the sunshine. To keep the tin in a condition which makes it easier to clean, line it with plantain leaves or old newspapers. When carried to the place where garbage is collected, show your good citizenship by emptying it carefully into the box, and do not let any garbage fall upon the ground. Exposed waste is a breeder of flies, and flies carry disease. Always keep the garbage tin, or basket, well covered. You have learned in Part I about the further disposal of garbage and waste water.

Care of cooking and eating utensils. The utensils in which our food is prepared, cooked and served, require the greatest cleanliness and care to prevent infection. Can you explain why? Dry dirt is easily wiped away with a dampened piece of mulmul. In the kitchen, dust is combined with fat, which makes it cling to the surfaces of the room and to the utensils. We must, therefore, first cut this greasy film before we can mechanically remove the dirt. You have learned that an acid will combine with an alkali metal to produce a salt. Grease contains the fatty acid and, therefore, if we use a base upon the greasy surface, the film

of fat will be cut by breaking up the fat into tiny particles, which can be washed off by the water or polished off with some abrasive substance.

Most metals will combine with the oxygen of the air when heated, and if moisture is present they combine slowly at ordinary temperatures. This film of oxide prevents the air coming in contact with the metal, and so oxidization ceases. Magnesium, zinc and aluminium form whitish tarnishes; lead forms a darker oxide. Platinum, gold and tin do not tarnish, and nickel tarnishes very slowly. Silver does not tarnish in the presence of pure air; but when sulphur compounds, such as are produced by burning coal, are present in the air, silver darkens. The sulphur in eggs will tarnish a silver spoon; rubber and wool also tarnish silver. That is why you do not put your bright bordered sari away with your woollen shawl. Copper and brass, which is an *alloy* of copper, being made of copper and zinc, will tarnish in the presence of air containing carbon dioxide as well as oxygen and moisture. The carbonate of copper is formed, which is soluble in weak acids. If the copper or brass chatti is bright and clean, acids cannot act upon it, for the smooth film of polished metal protects it.

When fruits or acid foods are cooked in a tarnished vessel, the copper carbonate is dissolved by the acid, and people eating the food may be poisoned.

Methods of cleaning vessels of different materials have already been studied in Part I, pp. 79–98.

To wash dishes. (1) Scrape off all the waste material on the eating utensils and cooking vessels. A bit of leaf or paper which can be burned is a good thing to use for this purpose. (2) Sort them according to the material of which they are made—brass with brass, silver with silver, glass with glass, etc., and place them on the *left*-hand side of the sink or wash-up table. (3) Prepare two chatties of hot water, if possible. Place a little soap or soda solution in the one

nearest the soiled dishes, on the left-hand side. Keep the other water clear for rinsing the dishes after they are washed. (4) Wash things in order of their cleanliness, taking glass first, china next, brass and silver last. As soon as an article is washed, dip it in the clear water to wash off the soap, and set it to drain on the *right*-hand side of the sink or table. (5) Dry them with a clean dry cloth, or set them in a clean place to drain. Metal must be made perfectly dry or it will tarnish or rust. Can you explain the chemical action which causes this to happen? (6) The cloths should be washed out at once, rinsed clean, and hung to dry, in the sun if possible.

Exercise 17. Try reversing the process by washing from right to left, and see if it requires more motions and takes longer.

Soap is the most convenient form in which to use an alkali.

You have learned in Part I how to make soap. Here is another method, and the explanation of the chemical changes which take place. Soap can be made with little expense beyond that of time and fuel.

Home-made soap. Begin by collecting the wood ashes from your fire. You may also collect the drippings of fat left in cooking, or you may buy til or coco-nut oil for the purpose. This is a chemical process, and I want you to understand what takes place in making soap.

Get a barrel—or a box will do if it is tilted up with blocks in such a way that you can catch what drips through the holes which you now bore in the bottom. Put a little dry grass over the holes, and put some chuna on this. Then put your wood ashes on top, and pour warm *rain* water over the ashes. Catch the liquid which percolates through the ashes and lime. Be careful not to get it on your hands or clothing, for it is *lye*.

Let us test this lye to see what it is composed of. First we will try litmus paper. It is strongly *alkaline*. Next we

will concentrate some of it by boiling it down, and test it with an acid. It does not effervesce and, as no carbon dioxide is given off, we know it is *not a carbonate*. Let us give it the flame test. By this means we can tell *what metal is present*, for the salts of different metals will burn each with a different colour. Dip a wire into the concentrated lye, and put it in a flame. What colour is it? If it is yellow we can conclude it is probably sodium, but if it is violet we will know it is potassium. Now test some of the chuna that was used in making the lye, with acid. It effervesces, and we conclude that carbon dioxide is present. Some chemical action has taken place. What was it? Evidently the CO_2 has left the potassium and combined with the lime, and we have produced lye and the carbonate of lime.

Wood ashes plus water plus lime equals lye plus carbonate of lime. The lye is known as potassium hydroxide (KOH) or potash.

To make the soap, the housewife now puts the fat and oil she has collected or purchased into a petrol tin, adds one measure of the lye to four measures of fat, and then she boils them together for a long time, stirring and watching to prevent the material from boiling over. Another chemical change will now take place between the lye and fat, changing them to soap. We call this process 'saponification'. If you have the right amount of lye for the fat, your soap will not be strong enough to burn the skin, but will feel soft and pleasant. This is due to the presence of glycerine. We can describe the change which has taken place as follows: fat plus lye equals soap plus glycerine.

This will be a *soft* soap, and is excellent for cleaning your utensils and cloths. If you wish to make hard soap, you must use caustic soda, or $NaOH$, instead of the lye or KOH.

You can make a small quantity of this soap in the laboratory by heating together in a chatti five tolas of fat with two

tolas of NaOH, dissolved in about five tolas of water, for fifteen minutes. Then add a tola of salt, and boil for half an hour. The soap will rise to the top of the liquid, and may be removed. Let it cool in a small box of wood or pasteboard.

Can you explain how soap will make your cloth clean when you wash it in water with a little soap added? Soap is decomposed by the water, and the alkali which is set free acts on the oily film of dirt in the dirty cloth or on your hands, forming a new soap with it. The fatty acid which is freed remains in the water.

Conclusion. Marriage is a partnership in the business of home-making. In other businesses the partners know very definitely what their aim is; what they intend to produce. They also balance their accounts each year at Diwali, and reckon up their profits. How are we to judge the success of our home-making project? What is our purpose in this business of home-making? These matters are often not considered in any definite way. Suppose you try to set down in writing the purposes you would wish to carry out in your own home. They would certainly include the rearing of a family. But how are we to determine our profit and loss? These will have to be valued by a different scale from commercial business. Would we not conclude that our business was a success just in proportion to the health, the happiness and general well-being of the members of the family? If, with all our work and expenditure of time, effort and money, the members of the family were sick, discouraged and unhappy, certainly we would conclude that the investment had been a poor one, or the business had been badly conducted.

A true home-maker would not consider a clean house, good cooking, and well-cared for clothing the ultimate object of life. These are only means to the end. We seek harmony, peace, freedom from anxiety, joy and happiness

for the family, and the work we perform has this object in view, that all may be able to 'live at their best, and serve most'.

The best Indian homes have high ideals of woman's place as wife and mother, and she has long realized her responsibility in training her children in right habits of thinking and conduct. The ritual in home affairs develops self-control, evenness of mind, and kindness. These are qualities to be cherished, and never bartered for worldly gain. But conditions are not ideal for some women. Custom has resulted in their physical degeneration, due to lack of fresh air and exercise and to insufficient food. They have had little intellectual opportunity, and so are ignorant of the physical laws which control health; invalidism and early death are the result. Education is necessary if women are to maintain their rightful position.

Mrs. Sarojini Naidu, speaking of India's future women, has said, 'We who dream dreams of the coming women of India have our hopes centred, not in the institutions that only slavishly imitate men's schools and colleges, but the institutions that would send forth to the world women not merely brought up and fed on the dry pages of lifeless books, but rather women trained in the beauties and necessities of life. These women would go forth not bearing the burden of dead knowledge, but culture transmitted in the services of humanity.'

AGENDA

Oral and Practical Work

1. What principle should control your dress when preparing food?
2. What two chief processes are carried out in the kitchen?
3. How would you arrange the kitchen equipment to save steps and any other unnecessary motions?
4. What is the most efficient posture when working?
5. What is the easiest height for work?
6. What type of stove is most economical for fuel?

7. How should utensils be arranged for greatest convenience?

8. Discuss the best methods for storage of both fresh and dry foods.

9. Why does food spoil? (See Chapter 1)

10. How should you care for the garbage and waste water?

11. Why do metal utensils tarnish?

12. What is the danger from unpolished brass and copper utensils?

13. How should we clean our metal vessels?

14. What is the correct way of washing dishes?

15. How is soap made? How does soap cleanse greasy materials?

Exercise 18.

1. Plan a kitchen that will be light, well-ventilated and convenient.

2. Try several methods of cleaning tarnished copper and brass to determine which is the most efficient.

3. Try washing dishes from right to left, and from left to right. Count the number of motions used by each method. Which requires the fewer motions?

4. Make some lye and soft soap.

5. Keep your personal expenses for six months, and work out the percentages of your expenditures.

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APPENDIX

ADDITIONAL RECIPES

Recipe 74. *Papadya*

Rice	1 maund	Til (sesame seed)	1 seer
Alum (fatakdi)	10 tolas	Water	1 gallon
Salt	3 lb.	Oil	2 seers

Soak the rice for six days and then grind. Combine alum, salt and til with the rice starch, and mix to a very thin paste. Place oil in the water, and heat in a vessel to boiling point. Cover with a cloth. Put metal lid on top of cloth. Drop some paste on the lid, and let cook for two minutes. Invert the lid, and steam the paste for five minutes. Place out in the sun on a cloth to dry.

Recipe 75. *Bran biscuits*

Maida or atta flour	4 oz.	Baking powder	2 tsp.
Salt	1 tsp.	Sugar	2 oz.
Butter	2 oz.	Bran	2 oz.

Enough milk to make a stiff dough.

Roll out thin, and cut with a knife into squares or rounds. Bake in a moderate oven. Very good for older children.

Recipe 76. *Foundation recipe for plain cake*

All measurements should be level and flour should be sifted before measuring.

Butter or ghee	4 tbsp.	Flour	$1\frac{1}{2}$ c.
Sugar	$\frac{2}{3}$ c.	Baking powder	2 tsp.
Egg	1	Flavouring	$\frac{1}{2}$–1 tsp.
Milk	$\frac{1}{2}$ c.	Salt	$\frac{1}{4}$ tsp.

Cream the ghee well; add the sugar gradually, continuing the creaming process until the mixture is light and fluffy. Stir in the beaten egg yolk. Add alternately the milk and the flour, previously sifted with baking powder and salt. Fold in thoroughly the stiffly beaten egg white.

Pour into well-greased tins, and bake in moderate oven.

Recipe 77. *Spice cake, with sour milk*

Sugar	1 c.	Nutmeg	$\frac{1}{2}$ tsp.
Ghee	$\frac{1}{2}$ c.	Cloves	1 tsp.
Sour milk	1 c.	Baking powder	1 tsp.
Eggs	2	Soda	$\frac{1}{2}$ tsp.
Salt	$\frac{1}{2}$ tsp.	Raisins	$\frac{1}{2}$ c.
Cinnamon	2 tsp.	Flour	$2\frac{1}{2}$ c.

Cream the sugar with the ghee; add the beaten eggs, stir in the sour milk, and the rest of the dry ingredients sifted together. Add the raisins, cut in pieces and dredge in flour.

Pour into greased or paper-lined loaf tin and bake in a moderate oven.

Recipe 78. *Milk frosting*

Sugar	$1\frac{1}{2}$ c.	Milk	$\frac{1}{2}$ c.
Butter	1 tsp.	Vanilla	$\frac{1}{2}$ tsp.

Melt butter in saucepan, add sugar and milk. Stir and then heat to boiling point and boil without stirring for 13 minutes. Remove from fire. Beat, flavour and spread.

Recipe 79. *Chocolate icing*

Bakers' chocolate (cut small)	3 oz. or 3 squares
Sugar	1 c.
Rich cream	3 tbsp.
Boiling water	1 tsp.

Put chocolate in double boiler, and melt and add other ingredients, stirring constantly, and let cook 5 to 8 minutes. Take off the stove, and beat the mixture rapidly for 10 minutes, adding 2 teaspoons of vanilla extract. It should be quite thick before spreading on cake.

Recipe 80. *Lemon filling for cake*

Sugar	$1\frac{1}{2}$ c.	Butter	$\frac{1}{2}$ c.
Eggs	4	Lemons, rind and juice of	3

Beat the butter and sugar till creamy. Put into double boiler, add eggs, lemon juice and finely-grated rind, and stir until thick. Makes two thick fillings.

Recipe 81. *Saffron rice (keshari bath)*

Fine rice	$\frac{1}{3}$ seer ($\frac{2}{3}$ cup)	Almonds	$\frac{1}{8}$ seer
Saffron	$\frac{1}{4}$ tola	Tiparis	$1\frac{1}{2}$ (1 lb.)
Sugar	$\frac{2}{3}$ seer ($1\frac{1}{3}$ cup)	Pistachio	$\frac{1}{8}$ seer
Cardamom	$\frac{1}{2}$ tola	Dried grapes	$\frac{1}{8}$ seer
Nutmeg	$\frac{1}{2}$ tola	Cloves	15

Ghee	2 tbsp.	Lemon (flavouring)	½ tsp.
Salt	½ tsp.		

Pick over the rice. The cardamoms and nutmeg should be reduced to a fine powder, the almonds and pistachios blanched, skins removed, and cut into fine pieces. Two table-spoons of ghee should be placed in a pot with the cloves, and placed on a stove. After the ghee becomes hot and begins to bubble, the rice should be put into it, and should be turned with a flat iron ladle until it becomes dry. About a seer of water should be poured into the pot, and the almonds and pistachio and saffron thrown in, and the whole should be allowed to boil. Then the sugar, along with the powder of cardamom and nutmeg and a half teaspoonful of salt, should be added, and after the whole is well cooked the juice of about half a lemon should be sprinkled over it before serving.

Recipe 82. *Bhendi or okra soup (Lady's-fingers)*

Sauté 1 lb. mutton, and cut into bits; put 2 tablespoons of ghee or butter into pan, and brown 1 sliced onion very slowly. Put all ingredients into 3 qts. water, boil slowly 1 hour; then add 1 pt. sliced okra, and simmer 2 hours. Add salt and pepper to taste. This will serve 12 portions. It can be made without the meat as well.

Recipe 83. *Mulligatawny soup*

Coco-nut, fresh	..	A piece about two inches square
Parched gram	..	⅛ seer
Mugfali (peanuts)	..	12
Cuscus (poppyseeds)	..	1 tola (1 tbsp.)
Ginger root	..	A piece the size of the end of your thumb
Halad (turmeric)	..	1 inch piece
Chilli	..	Piece two inches long
Dhania (coriander seed)	..	2 tolas (2 tbsp.)
Coriander leaves	..	A few sprigs
Jeera (cumin seed)	..	1 gunj
Rai (mustard seed)	..	1 gunj
Onion	..	1
Ghee	..	1 tola

All of the above materials, except the onion, are crushed between curry stones and ground to a fine powder. Water

is used in bringing them to this finely-pulverized state. Take about a pint of soup stock, that has previously been made from mutton. With this clear stock, the masala is strained through a fine mulmul. Fry the sliced onion in butter or ghee, until crisp brown. Then add it to the soup.

The soup is allowed to cool till it has thickness of rich cream. It is served with the pieces of mutton or fricasseed chicken in it. Cooked rice, with slices of sour lime, is eaten with the soup. Plantains may be served with it in place of bread.

Recipe 84. *Shev*

Gram flour	1 seer	Asafœtida	¼ tola
Salt	2 tolas	Garlic	5 tolas
Chilli powder	2 tolas	Curd	10 tolas
Turmeric	½ tola	Sweet oil	¾ seer
Cumin seed	1 tola		

Powder all the ingredients and mix them thoroughly with the gram flour and make a hard dough, and press the dough through a sieve into a frying-pan of hot oil.

Recipe 85. *Goda varan*

Tur dhal ..	⅛ seer
Salt ..	4 masa
Powdered turmeric (halad) ..	1 gunja
Powdered asafœtida ..	1 gunja

Wash the dal. Boil ¾ seer of water in a tinned brass chatti. Add salt when boiling and then the dal and cook for about half an hour until thoroughly done. Take off the segri.

Mix the turmeric and asafœtida in ¼ seer of water, add to the cooked dhal and boil all together for another five minutes.

Recipe 86. *Whole gram amti*

Yellow whole gram ..	½ seer
Powdered masala ..	2 tolas
Hot masala ..	1 masa
Powdered asafœtida ..	1 gunj
Cumin seed ..	1 gunj
Soda ..	1 gunj
Til oil ..	6 masas
Onion ..	1
Salt ..	4 masas

Tamarind (dried)	..	3 small pieces; or
Amsule (dried)	..	5 small pieces

The whole gram must be soaked overnight and then well washed. Put it, with the masala, asafœtida, cumin seed and soda, into ¾ seer of boiling water and cook for half an hour.

Slice the onion thin, fry it in the til oil, and add it with the salt and tamarind (on amsule) to the soup and boil for another five minutes.

Recipe 87. *Stewed chicken*

Dress a fowl and put it into boiling water, just enough to cover. The protein on the surface will harden, and hold in the juice. Reduce the fire and do not allow it to boil, but only simmer slowly. Add 1 teaspoonful of salt. Let it cook gently until *tender*. Remove it from the broth. Mix a tola of flour with milk to a smooth paste. Add some of the hot broth carefully, to avoid lumps, to thicken it.

This may be served with dumplings.

Dumpling, to be put into the stewed chicken broth.

1 cup of flour, 1 teaspoonful of salt, and 2 teaspoonfuls of baking powder. Add milk enough to make a soft dough. Cut into small pieces. While the broth is boiling hot, drop the pieces into it. Cover the pot very tightly, and *do not open it for 10 minutes.* Serve chicken on a dish with the hot dumplings, and pour the thickened broth over them. Hard boiled eggs make a nice garnish, and sprigs of parsley or coriander leaves.

Recipe 88. *Roast meat or fowl*

Let the meat rest on a rack in a dripping-pan, skin side down; dredge with flour, and sear over the outside in a hot oven. Then add salt, pepper and dripping, and cook at a low temperature until done, basting; i.e. dipping the melted fat in the pan over the meat every 10 minutes. Turn the roast in time to brown the skin side. Allow 15 minutes for each pound of meat. The roast should have a crisp brown exterior and juicy interior.

Recipe 89. *Pan-broiled chops*

Heat frying pan very hot, trim the chops, remove fat, and wipe with damp cloth; put chops in frying pan; when one side is seared, turn and sear the other, then reduce the

fire and cook more slowly. Turn the chops frequently, but do not pierce with a fork while turning. Cook from 6 to 10 minutes, according to thickness of chop. Season with salt and pepper, arrange on hot dish and serve at once.

Recipe 90. *Fish pulao*

Fine Rice	½ lb.	Onions	¼ lb.
Pomfret or other fish	1 lb.	Cumin seeds	1 spoonful
Coco-nut	1	Turmeric	1
Ghee	½ lb.	Red chilli	3 or 4
Cinnamon	1 small stick	Cloves	7
Green coriander	¼ lb.	Cardamoms	7
Salt as needed			

Take out the milk of coco-nut with hot water, slice coriander, and grind all the masala. Salt the fish and fry it in slices in ¼ lb. of ghee. After it is half cooked add ¾ seer water. When sufficiently done, remove the fish from the liquid. Wash the rice very clean in 2 or 3 changes of water. Put a chatti on the stove, and pour the remaining ghee into it, and add the rice, and fry it. Then add the milk of coco-nut, the liquid from the fish, and 1 tola salt, and cover it closely. Let it cook slowly, and when done open the cover and place the fish over the rice, and serve. If you want to prepare pulao of any kind, it may be done in a similar way.

Recipe 91. *Fish curry* (*mashyacha kaliva*)

Fish	1 lb.	Garlic	1 tola
Ghee	⅛ lb.	Salt	2 tolas
Curd	⅛ lb.	Methi vegetable	1 tola
Onions	¼ lb.	Cumin seed	1 tola
Red chilli	1 tola	Turmeric	1 tola
Green chilli	1 tola	Tamarind	2 tolas
Ginger	1 tola	Coriander seed	1 tola

The dried chillies to be well pounded in a mortar. The ginger, garlic, cumin seeds, methi vegetable, coriander seeds, turmeric and half of the onions to be mixed with the dried chillies, and well pounded or ground up together. The remaining half of the onions to be sliced and browned in ghee. The juice to be extracted from the tamarind and mixed with the curd, ghee, browned onions, green coriander leaves, and chillies, and added to the fish. Let the whole simmer until done.

For any curry the spices are the same, and the method

also the same. You can prepare curry of fowl, chicken, mutton, or any bird. If you want to make a curry of mutton and vegetable together, you can prepare curry and put vegetable in it.

Recipe 92. *Patiya of vinegar and fresh fish*

Large fish	2	Vinegar	½ pt.
Onions	½ lb.	Green coriander	¼ lb.
Ghee	5 tolas	Garlic	1 tola
Powder of red chilli	1 tola	Turmeric or cumin seeds	½ tola
Salt and rice flour, as needed			

Cut the large fish into pieces. Rub over it rice flour and salt, and put it aside for half an hour. Pound all the seasonings very finely. Put a chatti on the stove, with ghee and vinegar. Add fish, pounded masala, and take the chatti and shake it from time to time. When done and the liquid is absorbed, take off the chatti and serve.

Recipe 93. *Fried fish*

After cleaning, cut the fish into equal portions, and season with salt and pepper. The fish must be protected from the heat by some coating, of which one of the following may be used: (1) milk and flour (maida, atta or maize), (2) milk and fine dry bread-crumbs, (3) egg and fine dry bread-crumbs.

The fat should be quite hot, and as soon as the fish is brown the fat should be drained off by placing the fish on paper. Serve hot, with slices of lemon and garnish of coriander leaves.

Recipe 94. *Eggs and cheese*

The principle to be observed in cooking eggs is based upon the fact that heat coagulates protein at a temperature far below the boiling point. A boiling temperature hardens, and renders protein difficult to digest. The same precaution—not to overheat the protein—must be observed in cooking cheese.

Recipe 95. *Kababs*

Kababs are similar to croquettes, shaped into balls, rolled in flour and fried (without egg or bread crumbs). Serve with sauce or gravy.

Bread crumbs	4 tsp.	Hard-boiled eggs	10
Curry powder	4 tsp.	Salt	1 tola
Butter	4 tsp.		

Method. Pound all with bread crumbs. Mix thoroughly, and add the butter. Form as a kabab and fry in ghee, as needed.

Recipe 96. *Baked rice and cheese*

Cooked rice	3 c.		
Grated cheese	2 c.	Milk	1 c.
Salt	1 tsp.	Ghee	2 tbsp.
Crumbs		Cayenne	

Put a layer of cooked rice in a greased baking dish, cover with a layer of grated cheese, season with salt and cayenne. Continue adding layers until the dish is almost full. Add enough milk to come half-way to the top of the rice. Cover with crumbs, dot with ghee, and bake in a moderate oven until the crumbs brown.

Recipe 97. *Nut croquettes*

Almonds, blanched	24	Chopped parsley	1 tbsp.
Boiled rice, cold	1 c.	Pistachio nuts, chopped or ground very fine	1 c.
Salt	½ tsp.		
Onion juice	1 saltspoon	Pepper	1 saltspoon

Mix thoroughly, form into small croquettes, dip in milk, and roll in crumbs. Fry in ghee.

Recipe 98. *Barfi of pineapple*

Pine-apple syrup	1 lb.	Cardamoms	10
Sugar	1¼ lb.	Mawa	1¼ lb.
Saffron	A pinch	Almonds	5 tolas
		Pistachios	5 tolas

Make a hard syrup of the sugar, add the powdered saffron and cardamoms. Add all to the pine-apple syrup. Add mawa, pour into a dish, and sprinkle over it fine slices of pistachois and almonds. Let it get quite cold, and then cut into square pieces.

Recipe 99. *Mango fool*

Take six green mangoes, remove every particle of the green peel, cut them into four, and steep them in clean water; throw the stones away; boil the fruit to a perfectly

tender pulp, and pass it through a sieve; sweeten to your taste, and add to it very gradually, stirring all the while, as much good, pure milk as will reduce it to the consistency of a custard. It should be eaten on the day it is made.

Recipe 100. *Bottled peas*

Peas should be bottled directly after they are brought from the vines. For satisfactory results select pods that are well developed and green. After the pods have begun to wither, and the peas are hard, it is too late to bottle them.

Shell, plunge into boiling water for 5 minutes, and then into cold water. Pack in hot jars, within one inch of top; add hot water to cover; a teaspoonful of salt and a teaspoonful of sugar to each quart. Adjust rubber, cover, and clamp lightly. 2½ hours' boiling is enough for fresh, young peas, 3 hours is safer, if the peas have been bought or are not strictly fresh-picked.

A cloudy appearance of the liquid in the jar after a few days does not necessarily mean spoilage, but that the peas were carelessly handled, breaking the capsule which encloses the starch, and allowing this to be set free.

If large quantities of peas are picked in the heat, do not allow them to stand in boxes or baskets. The flavour is spoiled by heating while standing in bulk. They should be spread out on tables until shelled, or they will heat through rapidly and be unfit for bottling.

Recipe 101. *Mango koshimbeer (made daily)*

Pare and mince 1 green mango, 1 onion, 2 green chillies, and ½ inch of fresh ginger. Mix the whole together with salt to taste, and lastly stir in 2 tablespoons thick coco-nut milk.

Recipe 102. *Pakka kela koshimbeer*

Round slices of plantains	5 tolas
Sugar	3 tolas
Curds	6 tolas

Take round slices of plantain and place into the curds. Add sugar also, and mix together and serve.

Recipe 103. *Roselle chutney*

Take 5 lb. roselles, remove the seeds, and wipe the fruit carefully in a clean cloth. Grind in best vinegar, separately, the following ingredients:

Roselles	5 lb.	Red chillies	2 oz.
Raisins	2 lb.	Garlic	4 oz.
Green ginger	4 oz.	Salt	4 oz.
Peppercorns	1 tsp.	Cinnamon	2 inches
Cloves	6	Cardamom seeds	4
Brown sugar	2 lb.		

Method. Mix all well together, taste the chutney, and supply more chillies or sugar if not sweet or hot enough. Bottle, and cork tightly.

Recipe 104. *Sweet mango chutney*

Boil gently together 3 seers of green mangoes, cut in small pieces, and 3 seers of sugar, till of the consistency of jam. Add to the latter ¼ seer each of green ginger and garlic, sliced, 2½ tolas of dry chillies, pounded and sifted, and 1 seer of raisins. Simmer for 6 minutes longer. Stir in the chutney half a bottle of good vinegar, and salt to taste. Boil it up once more.

Recipe 105. *Fresh chutney (of three kinds)*

(1)	Green mango	1	Chillies	2
	Garlic clove	1	Sugar	2 tsp.
	Mint	1 bunch		
(2)	Green mango	1	Thick cream	1 tbsp.
	Salt and cayenne pepper			
(3)	Fresh coco-nut ground with a little garlic		Salt	
	Green chilli	1	Lime juice, or Tamarind.	

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